

THE YALE JOURNAL OF WORLD PUBLIC ORDER

Volume 9, Number 2, Spring 1983

The Public Order of the Geostationary Orbit: Blueprints for the Future*

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The use of space has grown exponentially. It is impossible today to conceive of international communications, weather forecasting, or the screening of the riches of the earth without the help of space-based devices.¹ Full-scale industrialization of outer space is under way, and space has become a critical arena for military strategists in the global duel.

Many of these uses can be performed successfully only by placing a satellite at a very special location in outer space, the so-called geostationary orbit. Only in this ring high above the earth's equator can space objects be maintained in a fairly stable position relative to the earth. In 1963, the United States launched the first geostationary satellite, Syncom-2. Since then, demand for positions in the orbit has grown rapidly. The rigid constraints of science and technology further stimulate fierce competition.

With ever-growing use, saturation of the geostationary orbit has become a matter of widespread concern. In particular, countries less advanced in space technology fear that these valuable orbital positions will be fully occupied before they are capable of launching their own devices. Inclusive arenas have come to deal with the issue, primarily the Interna-

* The starting point for these deliberations was an article written with my Tübingen colleague Rüdiger Jung, to whom I am deeply indebted: Wiessner & Jung, *Das völkerrechtliche Regime der geostationären Umlaufbahn*, 32 ÖSTERREICHISCHE ZEITSCHRIFT FÜR ÖFFENTLICHES RECHT UND VÖLKERRECHT 209 (1982). I also acknowledge invaluable comments and criticism by Professors Myres S. McDougal, W. Michael Reisman, Eugene V. Rostow, Leon S. Lipson, Harry H. Almond Jr., and Carl Q. Christol, as well as by my friends and colleagues at the Yale Law School, Adeno Addis, Keith D. Nunes, and Emilio Sahurie.

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1. The seminal work on the law of outer space, M. McDougal, H. LASSWELL, & I. VLASIC, *LAW AND PUBLIC ORDER IN SPACE* (1963), makes reference to the earth-space arena as "mankind's most comprehensive community." *Id.* at 3.

tional Telecommunication Union (ITU) and the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS). The public order of the geostationary orbit is an annually recurring topic of the agenda of UNCOPUOS, and the ITU will devote a two-session world administrative radio conference in 1985 and 1988 to the use of the geostationary orbit and the planning of space services utilizing it. Consensus has been reached that the geostationary orbit is a limited natural resource, the limits of which may soon be reached, and access to which has to be provided on an equitable basis.

This Article explores the specific nature and community relevance of the geostationary orbit, the claims raised and trends in decision with respect to its use, and possible regimes under which this finite and precious resource can be distributed among the numerous claimants in the world community. It proposes a flexible framework of inclusive control over the area, based on the view of the orbit as a *res publica internationalis*.

I. The Factual Setting

A. Physical Characteristics of the Geostationary Orbit

According to Kepler's laws, the orbit plane of a satellite has to cross the central point of the earth. Most satellites' orbits are elliptical, which means that their positions relative to the earth change continuously. That, in turn, requires constant readjustment of antennae of both the satellite and the ground stations.

However, circular orbits are also available. One of them, the geostationary orbit², encircles the earth some 22,300 miles (35,786 kilometers)³ above the equator. In this orbit, satellites can be placed so as to turn

2. Terminology varies. The ITU consistently refers to the area as the "geostationary-satellite orbit", defined as "[t]he orbit in which a satellite must be placed to be a geostationary satellite." Final Acts of the 1979 World Administrative Radio Conference, Radio Regulations, No. 182, at 47, 47 C.F.R. § 2.1 (hereinafter cited as WARC 1979). A geostationary satellite is described as a "geosynchronous satellite whose circular and direct orbit lies in the plane of the Earth's equator and which thus remains fixed relative to the Earth; by extension, a satellite which remains approximately fixed relative to the Earth." *Id.*, Radio Regulations no. 181, at 47. The broadest term is thus "geosynchronous satellite," which is defined as an "earth satellite whose period of revolution is equal to the period of the rotation of the Earth about its axis." *Id.*, Radio Regulations no. 180, at 47. UNCOPUOS, on the other hand, refers to the area as the "geostationary orbit." See, e.g., Report of the Committee on the Peaceful Uses of Outer Space, 38 U.N. GAOR Supp. (No. 20) at 11, U.N. Doc. A/38/20 (1983). The latter designation, though less precise, has the advantage of brevity.

3. There is some disagreement about the exact altitude of the orbit. Compare C. CHRISTOL, THE MODERN INTERNATIONAL LAW OF OUTER SPACE 3 (1982) with Gorove, *The Geostationary Orbit: Issues of Law and Policy*, 73 AM. J. INT'L. L. 444, 445 (1979). See also Perek, *Physics, Uses and Regulation of the Geostationary Orbit, or Ex Facto Sequitur Lex*, PROC. 20TH COLL. ON THE LAW OF OUTER SPACE 400, 402 (1978) (deriving the figure quoted in the text from, *inter alia*, Kepler's Third Law).

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about the polar axis of the earth in the same direction and within the same period as the earth itself.⁴ Thus, they appear stationary to the earth-bound observer, as if fixed in the sky.

The geostationary orbit is a complicated astrophysical phenomenon. It involves not only the gravitational attraction of the earth, but also minute forces resulting from the ellipticity of the equator, the attraction of moon and sun, and solar radiation pressure. The initial position of satellite in orbit is determined by its launch and subsequent rocket impulses. Even then, natural forces alone would not keep the device in its intended place in space; periodic station-keeping maneuvers have to be made in order to maintain the satellite within tolerances of ± 0.05 degrees in both latitude and longitude on this circular orbit⁵ – the maximum accuracy achievable with present-day technology.⁶

Most satellites orbit at levels well below the geostationary height since it is very costly to elevate space vehicles to that altitude. A geostationary orbit is used primarily when its specific benefits are crucial for the mission of the satellite, or, to put it differently, when there is no less expensive substitute. The main advantages of geostationary orbit may be summed up as follows:

1. The geostationary orbit is the only flight path capable of providing continuous contact between ground station and satellite without constant readjustment of antennae.
2. A geostationary satellite has a constant view of a large area of the earth, and continual visibility from any point within this area is precondition for telecommunication.
3. One satellite alone can supply one-third of the earth's surface with radio signals. Three satellites, therefore, can set up a global telecommunication network.

4. See *supra* note 2, and Gorove, *supra* note 3, at 445.

5. Technical Bases for the World Administrative Radio Conference on the Use of the Geostationary-Satellite Orbit and the Planning of the Space Services Utilizing It (WARC-ORB), ITU, Report of the CCIR Conference Preparatory Meeting (CPM), Geneva, 25 June-20 July 1984, (hereinafter cited as Technical Bases), Part II, at 40.

6. Previous technology allowed maximum tolerances of ± 0.1 degrees. See Gibbons, *Orbital Saturation: The Necessity for International Regulation of Geosynchronous Orbits*, 9 CAL. WEST. INT'L. L. J. 139 (1979). See also Perek, *supra* note 3, at 403.

7. By the end of 1980, there were 1,058 satellites in earth orbit, sixteen in lunar orbit and 36 in solar/planetary orbit. C. CHRISTOL, *supra* note 3, at 4. As of December 31, 1982, the geostationary orbit harbored 108 active and 41 inactive satellites. Physical Nature and Technical Attributes of the Geostationary Orbit, U.N. Secretariat Study, Committee on the Peaceful Uses of Outer Space, U.N. Doc. A/AC.105/203/Add.4 at 3 (May 18, 1983) (hereinafter cited as Physical Nature).

B. The Uses of the Geostationary Orbit

The main use of the geostationary orbit to date has been for communications, both domestic and international. Many countries have leapfrogged the traditional stage of telecommunications via terrestrial cable by establishing a nationwide satellite communications system. For remote areas of a country, this has often proven to be the only reliable means of communication.⁸ Innovative international uses have been developed continually by Intelsat, including long-distance telephone, telex, and other record traffic.⁹ This movement away from cable, wire, or wireless transmission is encouraged by a dramatic decrease in the costs of satellite communications.¹⁰ For commercial users, satellites provide access to distant computers and data banks; they also promote electronic publishing.¹¹

A "technology inversion"¹² with considerable impact on society is taking place in the field of television broadcasting. In the dawn of the space age, signals from tiny satellites could only be received by large, complex, and expensive earth stations, and then sent to conventional TV transmitters for rebroadcasting. Today's spacecraft are larger, more sophisticated, and powerful, enabling the receiving equipment to become simpler, smaller, and cheaper.¹³ Thus direct broadcasting by satellite (DBS)¹⁴ was born: direct reception of satellite radio signals through a dish antenna of 3-4 feet (1m) diameter by individual homes. Early experimental uses of DBS included educational, cultural, and medical pro-

8. Domestic satellite communications systems are operational in Canada, the United States, the U.S.S.R., Indonesia, Europe, Japan, and India. They are planned for Brazil and the Arab states. Letter from ITU official (Oct. 17, 1984) (on file with Yale Journal of World Public Order).

9. Technical Bases, *supra* note 5, Part II, at 32-33. See also Gibbons, *supra* note 6, at 140.

10. A satellite of the Intelsat-I series (1965) could only handle 240 telephone calls at a time, with annual costs per channel amounting to \$32,000. Intelsat-IVa (1977) was capable of handling 8,000 calls at once, at annual per channel cost of only \$6,840. E. HERTER & H. RUPP, NACHRICHTENÜBERTRAGUNG ÜBER SATELLITEN 77 (1979). By July 1984 annual costs per channel had dropped to \$4,680. Intelsat Director General Richard R. Colino. 50 TELECOMM. REPTS. No. 26, at 22 (July 2, 1984).

11. Perek, *supra* note 3, at 411.

12. U.N. Chronicle, July 1982, at 54.

13. *Id.* Indicators of this change are the weights and sizes of antennae carried by satellites. Intelsats I and III, launched in the 1960s, were equipped with comparatively tiny antennae. Intelsat-IVa, launched in 1977, weighed 1,500 kg (3,037 pounds), and used an antenna 1.27 m (4 feet). The weight of Intelsat-V (1982) was estimated at 1,950 kg (4,300 pounds), and its antenna measured 2.44 m across (8 feet). By comparison, the first experimental direct broadcasting satellite, ATS-6, was equipped with a 9 m (30 feet) antenna, and 3 m (10 feet) antennae were used to receive its signals. See C. CHRISTOL, *supra* note 3, at 3-4.

14. See K. QUEENEY, DIRECT BROADCAST SATELLITES AND THE UNITED NATIONS (1978), for DBS technology and problems of regulating it.

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grams for developing countries.¹⁵ DBS is now entering the media markets of highly industrialized states, in particular the United States¹⁶ and Western Europe.¹⁷ Its advent promises tectonic shifts in carefully balanced internal media structures.¹⁸

Another important use of the geostationary corridor is meteorology. Weather satellites are essential in forecasting and thus mitigating the effects of natural disasters such as tropical storms,¹⁹ excessive rainfalls, and crop-killing frigid weather.²⁰ Since 1979, a global network of five geostationary meteorological satellites has provided worldwide scientific information through the World Meteorological Organization's Global Atmospheric Research Programme.²¹

15. ATS-6 beamed these programs to remote areas of India. See *supra* note 13. It was launched in 1974. U.N. Chronicle, *supra* note 12, at 54. Similar projects are now run by the United States Agency for International Development's Rural Satellite Programme in the West Indies and Peru with a view towards assisting rural areas in education, health care, and agriculture. Another such pilot program was scheduled to begin operation in Indonesia in fall 1983. Remarks of Mr. Sherman, U.S. delegate, Committee on the Peaceful Uses of Outer Space (249th mtg.), U.N. Doc. A/AC.105/PV.249, at 28 (1983)(verbatim record).

16. United Satellite Communications Inc. has provided low-power DBS services since November 1983. N.Y. Times, Dec. 1, 1984, at 32, col. 1. Comsat's plans to provide high-power DBS services in the U.S. by 1986 were called off on November 30, 1984. *Id.*, at 31, col. 1. There are, however, other applicants, of which seven hold a DBS construction permit. Cf. *In re Applications of CBS, Inc., et al.*, FCC 84-477, released Oct. 10, 1984; *In re Applications of Satellite Syndicated Systems, Inc., et al.*, FCC 84-608 (released Dec. 6, 1984). As to the economics of DBS, cf. 107 BROADCASTING, Dec. 10, 1984, at 46.

17. Under the German-French Satellite Treaty of April 29, 1980, two experimental DBS satellites are to be constructed. The German TV Sat and the French TDF 1 are planned to be launched in April 1985, for a pre-operational phase of at least two years. See Gross, LÄNDERKOORDINIERUNG IN DER MEDIENPOLITIK, 36 DIE ÖFFENTLICHE VERWALTUNG 437, 442 (1983). The government of Luxembourg has notified the ITU of its intention to beam up to sixteen channels of programming to virtually every home by 1986. Washington Post, Oct. 13, 1983, at C19, col. 1. The USSR has had an operational DBS system for several years now. Japan operates a 12 GHz broadcasting satellite system. The Indian national satellite INSAT carries direct broadcasting transponders in the 2.5 GHz band, just as Arabsat will do, a satellite to be launched in 1985. See *supra* note 8.

18. For U.S. plans regarding DBS see FCC Report and Order Authorizing DBS, 90 F.C.C. 2d 676, at 678 (1982). See also the FCC's interim rules for the licensing and operation of DBS, 47 Fed. Reg. 31,574 (1982) (to be codified at C.F.R. pt. 100). For a comprehensive discussion, see The Georgetown Space Law Group, DBS UNDER FCC AND INTERNATIONAL REGULATION, 37 VAND. L. REV. 67 (1984). On the changes in German media law, see Oppermann, AUF DEM WEGE ZUR GEMISCHTEN RUNDFUNKVERFASSUNG IN DER BUNDESREPUBLIK DEUTSCHLAND, JURISTENZEITUNG 1981, at 721-30.

19. See the remarks of Mr. Garcia (Philippines) regarding efforts by the World Meteorological Organization (WMO) to mitigate the disastrous consequences of typhoons. Committee on the Peaceful Uses of Outer Space, (248th mtg.), U.N. Doc. A/AC.105/PV.248, at 57 (1983)(verbatim record).

20. C. CHRISTOL, *supra* note 3, at 8.

21. U.N. Chronicle, *supra* note 12, at 51. This is the first global telecommunications network. It is composed of the U.S. satellites GOES 1 (serving at 75° W) and GOES 2 (140° W), the ESA-METEOSAT (0° E), the U.S.S.R.'s GOMS (70° E), and the Japanese GMS (140° E). Perek, *supra* note 3, at 411. Continued operation of both polar-orbiting and geostationary weather satellites is essential for the World Weather Watch system.

Furthermore, geostationary satellites are used to observe the environment.²² They are also involved in one of the most controversial uses of satellites: remote sensing.²³ This screening and monitoring of the earth's resources with the help of sophisticated photometric systems allows the user to identify discrete terrestrial mineral resources, to locate underground water flows, to establish land and forest inventories,²⁴ to estimate yields of crops, and to assess the marine environment.²⁵ It has been said that "[i]n monetary terms this single application of space science and technology has made space programs economically viable."²⁶

A geostationary orbit also offers some disadvantages for remote sensing. Space vehicles in this corridor need more powerful optical systems to achieve the same spatial resolution as satellites in low orbit. The view of territories from high altitudes is rather oblique, and one satellite could serve only part of the world. That is why the U.S. sensing devices, the Landsat satellites, do not orbit at the geostationary level. However, among the advantages of this orbit are continuous coverage of the area within view, and more precise photometric measurements than those possible with rapidly moving low-orbit satellites. Thus, the United States plans the launching of a Synchronous Earth Orbiting Satellite (SEOS) for studying short-lived phenomena such as floods, storms, and pollution.²⁷

One classic use of the geostationary orbit is assistance to navigation.

22. For this purpose, the United States launched in 1983 a Geostationary Operational Environmental Satellite, GOES 6. Monitoring of the environment is also one of Canada's main uses of space technology.

23. Remote sensing is a longstanding item on the agenda of UNCOPUOS. The latest texts of draft principles are to be found in the 1983 Report of the Legal Sub-Committee on the Work of its Second Session (21 Mar. - 8 Apr.), Committee on the Peaceful Uses of Outer Space, U.N. Doc. A/AC.105/320, at 16-21 (1983). The basic conflict is expressed as a battle of principles: freedom of exploration and use of outer space (invoked by sensing states) versus a state's permanent sovereignty over its natural resources, including information about them (invoked by observed states). See Christol, *Remote Sensing and International Law*, 5 ANN. AIR & SPACE L. 375 (1980); C. CHRISTOL, *supra* note 3, at 720.

24. In 1975 land cover and land use maps were produced for the first time for Bolivia with Landsat imagery. In 1976, Landsat maps were employed to plan Bolivia's national population and housing census. A similar comprehensive space survey was made of the Mongolian People's Republic with the help of Soviet spacecraft imagery. U.N. Chronicle, *supra* note 12, at 53. The Amazon basin was also mapped from outer space to aid bridge construction. C. CHRISTOL, *supra* note 3, at 8.

25. Landsat imagery is used to assess marine living resources to guide fisheries. See the remarks of Mr. Howard, Committee on the Peaceful Uses of Outer Space (250th mtg.), U.N. Doc. A/AC.105/PV.250, at 27 (1983)(verbatim record).

26. C. CHRISTOL, *supra* note 3, at 8. The value of the Landsat program tripled from 1982 to 1983. According to Christol, developing countries "have derived specific benefits" from Landsat activities. During 1973, one year after Landsat-1, the first remote sensing satellite, was in orbit, there were more than 13,000 foreign requests for data, and in 1974 and 1975, between 5,000 and 7,000 requests per month were received by the United States EROS Data Center. *Id.*

27. Perek, *supra* note 3, at 411-12.

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Air traffic especially needs frequent and precise determinations of position.²⁸ As to ships and offshore facilities, there is already an international system of radionavigation via satellite: INMARSAT, in operation since 1982.²⁹ Even for the space shuttle and other spacecraft, communication and tracking support is now rendered via satellite.³⁰ The COSPAS-SAR-SAT satellite search and rescue system has already saved nearly 300 lives in aircraft and maritime emergencies.³¹

In addition, some specific research programs have to be performed from platforms in the geostationary orbit, because these observations have to be made at wave lengths inaccessible from the ground. That is true, in particular, for the fields of solar and stellar astronomy as well as for high-energy and plasma physics.³²

It would be naive, finally, to overlook the fact that the area is also used in many ways for national security.³³ More than one-third of all objects

28. This was made clear by the recent interception of a Korean airliner straying off course over Soviet territory. An international satellite system for commercial aerial navigation would assist in preventing such deviations in the future. See generally Perek, *supra* note 3, at 412; C. CHRISTOL, *supra* note 3, at 7.

29. INMARSAT has been praised as an "outstanding example of modern international cooperation overcoming the saturation of frequencies, which caused long delays for shipping." It also was considered to increase "the efficiency of navigation and the safety of life at sea" and to contribute to the "important development of transfrontier ground stations." Fawcett, *INMARSAT*, 5 ENC. PUB. INT'L L. 35, 37 (1983). On the internal level, the United States has developed MARISAT, a national ocean service.

30. Since its launch in April, 1983, TDRS-A, at 11,000 kg, is the largest communications satellite ever sent to space. This "Tracking and Data Relay Satellite" is the first link in a worldwide three-spacecraft system which will provide essential communications and tracking support and which will eventually replace the network of ground tracking stations now used with spacecraft in earth orbit. See the remarks of Mr. Sherman, *supra* note 15, at 31. After some initial problems, TDRS-A has now been safely deployed in geostationary orbit, and was already rendering useful services during the Spacelab mission in November and December 1983.

31. Washington Post, Oct. 19, 1984, at A26, col. 4. See also the remarks of Mr. Sherman, Committee on the Peaceful Uses of Outer Space *supra* note 15, at 28. The system's operators include the U.S., the U.S.S.R., Canada and France. It began its demonstration and evaluation phase in January 1983, and by summer 1983 had already saved the lives of dozens of citizens from the U.S., Canada, the U.K., France, and Spain, thereby justifying the designation of the mission by the Russian delegate to UNCOPUOS as a mission truly "international in purpose." Remarks of Mr. Troyanovsky, Committee on the Peaceful Uses of Outer Space (247th mtg.), U.N. Doc. A/AC.105/PV.247, at 12 (1983)(verbatim record).

32. Perek, *supra* note 3, at 412.

33. Under the Convention on the Registration of Objects Launched into Outer Space, U.N. Doc. A/Res. 1721 Art. IV(1)(e)(1961), states need only report the general function of a space object to the Secretary-General of the ITU. This minimal requirement has been criticized as allowing states to conceal military activities in space, in that "no space mission has ever been reported by these powers as serving military purposes." Vlasic, *Disarmament Decade, Outer Space and International Law*, 26 McGILL. L.J. 135, 191 (1981). The present population of the geostationary orbit includes 17 active satellites concerned with "research, experiment, meteorology," 74 communications satellites, and 17 "national means of verification and/or early warning." Physical Nature, *supra* note 7, at 3. For an account of military space activities, see Stockholm International Peace Research Institute (SIPRI), THE ARMS RACE AND ARMS

in the geostationary orbit are used for military activities.³⁴ Almost three quarters of the United States' military communications are performed via satellites in this corridor.³⁵ Seventeen satellites in geostationary orbit are characterized as "national means of verification and/or early warning."³⁶ They perform a crucial function for the maintenance of minimum world public order by verifying arms control agreements³⁷ and continuously monitoring the surface of the earth in order to detect launches of nuclear missiles. These satellites essentially meet the security concerns lying at the heart of President Eisenhower's "open skies" proposal of 1955³⁸ by providing relative confidence and stability of expectations between the two superpowers.

The future of the geostationary orbit is bright. For the next century,

CONTROL (1982), especially chapter 5 at 97-114 and Table 5.1, at 110-11 (hereinafter cited as SIPRI).

34. Physical Nature, *supra* note 7, at 8.

35. POPULAR COM. (hereinafter cited as SIPRI) No. 5, January 1983, at 65. For information on Soviet military uses of space, see SIPRI, *supra* note 33, at 97-114; J. OBERG, RED STAR IN ORBIT (1981); W. SCHAUER, THE POLITICS OF SPACE (1976); J. CANAN, WAR IN SPACE (1982); and Hoeber & Dannenberg, *Moscow and the Military Use of Space*, 32 PROBS. OF COMMUNISM 61 (May-June 1983). Some scientists recently suggested using the geostationary orbit for a space-based defense system along the lines proposed by President Reagan. See 38 Der Spiegel, No. 2, at 118. See also N.Y. Times, March 25, 1983, at A1, col. 4.

36. Physical Nature, *supra* note 7, at 3.

37. Mutual acceptance of both superpowers' surveillance devices is expressed in Article XII of the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems (ABM Agreement) of May 26, 1972, concluded in the framework of SALT I:

- (1) For the purpose of providing assurance of compliance with the provisions of this Treaty, each Party shall use national technical means of verification at its disposal in a manner consistent with generally recognized principles of international law.
- (2) Each Party undertakes not to interfere with the national technical means of verification of the other Party operating in accordance with paragraph 1 of this Article.
- (3) Each Party undertakes not to use deliberate concealment measures which impede verification by national technical means of compliance with the provisions of this Treaty.

23 U.S.T. 3435, T.I.A.S. No. 7503.

"National technical means of verification" include primarily reconnaissance satellites, but also seismic and radar monitoring. See Greenwood, *Reconnaissance and Arms Control*, 228 SCI. AM. 14, 24 (1973). See also M. McDougal & W. Reisman, INTERNATIONAL LAW IN CONTEMPORARY PERSPECTIVE: THE PUBLIC ORDER OF THE WORLD COMMUNITY 510 (1981).

38. See the Statement of the President Proposing Reciprocal Aerial Inspection of July 21, 1955. He suggested to the U.S.S.R.:

to provide within our countries facilities for aerial photography to the other country - we to provide you the facilities within our country, ample facilities for aerial reconnaissance, where you can make all the pictures you choose and take them to your own country to study, you to provide exactly the same facilities for us and we to make these examinations, and by this step to convince the world that we are providing as between ourselves against the possibility of great surprise attack, thus lessening danger and relaxing tension.

DOCUMENTS ON AMERICAN FOREIGN RELATIONS 1955, 215-216, reprinted in M. McDougal & W. Reisman, *supra* note 37, at 508.

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space structures are envisioned which would collect solar radiation energy, transform it into microwaves, and send it through an antenna to the earth. On the ground, a rectifying antenna would receive the microwave radiation and convert it into electricity.³⁹ The proposed generating capacity of twenty to thirty of these solar power satellites would equal all the electric power generated in the U.S. in 1975.⁴⁰ However, a "dedicated fleet of perhaps five space shuttles each making 100 round trips would be required to transport the material into low orbit where they would be assembled into the array and subsequently boosted into geostationary orbit. The whole operation presumably will require several years."⁴¹

C. Constraints on the Utilization of the Geostationary Orbit

All these uses have to take place in a tunnel-like ring of about 161,500 miles in circumference. Each degree of the arc thus represents 448 miles.⁴² Spacecraft have to be accommodated on this orbital belt like pearls on a string. As stated above, the highest accuracy of station-keeping that can be achieved with present-day technology is $\pm 0.05^\circ$.⁴³

The danger of physical collision of spacecraft is the first, physical, constraint to the use of this orbit. In order to avert it, satellites have to be placed at a distance of 0.1° from one another.⁴⁴ Inclusive decision-making processes, until very recently, did not take this factor into account. Thus, the 1977 ITU World Administrative Radio Conference for the

39. Perck, *supra* note 3, at 412. The nature of microwave transmission does not differ basically from other uses of the spectrum except for density. However, its purpose is different: power transmission instead of telecommunications. As to the frequencies under consideration, 2.45 GHz is preferred. Gorove, *Legal Aspects of Solar Power Satellites: Focus on Microwave Standards*, PROC. 22ND COLL. ON THE LAW OF OUTER SPACE 1 (1980).

These solar power satellites will be huge. Estimates range from energy gathering arrays of 50 km^2 to collecting areas of $100-200 \text{ km}^2$ with a thermal concentrator of 30 km^2 . See C. CHRISTOL, *supra* note 3, at 4; Perck, *supra* note 3, at 412. The weight of the solar cells alone would approximate 20 tons. See Wiewiorowska, *Legal and Political Problems of the Solar Power Stations in Space*, PROC. 22ND COLL. ON THE LAW OF OUTER SPACE 23 (1980).

A station's antenna for microwave transmission will measure 1 km in diameter and will beam the solar power down to earth in a corridor of roughly 10 km^2 . The receiving antenna will measure $8.5 \text{ by } 11 \text{ km}^2$. C. CHRISTOL, *supra* note 3, at 4; Perck, *supra* note 3, at 412; Gorove, *supra* at 2.

40. Gorove, *supra* note 39, at 1. Estimates of output from each solar station range from 5 to 10 GW. See Dupas, *Problems of Satellite Solar Power Stations*, PROC. 22ND COLL. ON THE LAW OF OUTER SPACE 273, 274 (1980); Perck, *supra* note 3, at 412.

41. Wiewiorowska, *supra* note 39, at 23. Dupas points out that there must be about 50,000 launchings of heavy lift vehicles between the years 2000 and 2025 to build 100 5 GW solar power stations. Dupas, *supra* note 40, at 274.

42. Gibbons, *supra* note 6, at 148.

43. Technical Bases, *supra* note 5, Part II, at 40.

44. This figure is, to be sure, subject to changes with advances in the technology of station-keeping.

Planning of the Broadcasting-Satellite Service (WARC-BS) assigned to seven states the "nominal orbital position" of 19° W.⁴⁵ Even if such nominal positions could be subdivided, satellites would come very close together at the borders of their slots. Some such close encounters leading to emergency evasive maneuvers have already taken place,⁴⁶ disproving earlier expectations that there would be no practical problem of collisions between active satellites.⁴⁷ The greatest collision hazard in geostationary orbit, however, is posed by the increasing amount of space debris, i.e., inactive, drifting and disintegrating space objects. If fuel for course corrections runs out, the satellite is acted upon by natural forces only. It then performs a "figure 8" of increasing size combined with a slow oscillation in longitude,⁴⁸ until it finally comes to rest in a new geostationary location at either one of two stable points: at about 90° W, above the Galapagos Islands, or at about 80° E, south of Sri Lanka.⁴⁹ Data from Early Bird and other Intelsat satellites confirm that inactive satellites stray in altitude by about \pm 60 km from the nominal value, with inclinations exceeding 0.5°. They traverse the equatorial plane daily within an annular lane 120 km wide, with an area 32 by 100 km². New active satellites stray in altitude only up to \pm 15 km. They have thus been called "ducks sitting in the central part of the lane," waiting to be hit by

45. That nominal slot for DBS is shared by Austria, Belgium, the Federal Republic of Germany, Italy, Luxembourg, the Netherlands, and Switzerland. Gross, *supra* note 17, at 442-43; ITU, 22ND REPORT ON TELECOMMUNICATIONS AND THE PEACEFUL USES OF OUTER SPACE (1983). However, the 1977 WARC-BS Plan for DBS was based on a uniform spacing of 6°. The 1983 DBS Plan for Region 2 (the Americas) is based on non-uniform spacing, but even in satellite clusters a minimum distance of \pm 0.1° in the east-west direction has to be kept by each spacecraft. Final Acts of the Regional Administrative Conference for the Planning of the Broadcasting-Satellite Service in Region 2, July 17, 1983, Part II, p. 38 (a copy of this preliminary version has been kindly made available to me by the FCC)(on file with the Yale Journal of World Public Order) (hereinafter cited as SAT-83). According to the current ITU rules, the "tolerance is \pm 0.1° for satellites using fixed-satellite and broadcasting-satellite allocations and \pm 0.5° for other satellites with further relaxations in certain circumstances." Technical Bases, *supra* note 5, Part II, at 99.

46. Within a sample of 21 satellites observed over a six month period in the second half of 1981, there were 120 predicted encounters within a 50 km miss distance. Several close approach predictions in the 1 to 5 km range resulted in collision avoidance maneuvers. FLTSATCOM-1, operating at 100° W, had eight close encounters with SBS-1, five of which were between 2.6 km and 6.0 km, and five additional close encounters with four other satellites. Due to inaccuracies in determining spacecraft positions and orbits, a finite probability of collision existed in most of these situations. Wolfe, Chobotov & Bond, *Man-Made Space Debris Implications for the Future*, cited in Physical Nature, *supra* note 7, at 8-9. Collisions with military satellites such as FLTSATCOM could arouse fears that an anti-satellite weapon had been used and so gravely endanger world peace. *Id.*

47. Perek, *supra* note 3, at 404.

48. *Id.* at 403.

49. Valters, *Perspectives in the Emerging Law of Satellite Communication*, 5 STAN. J. INT'L STUD. 53, 71 (1970). A more recent source locates these stable points at about 75° E and 105° W. Physical Nature, *supra* note 7, at 7.

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these drifting satellites passing through.⁵⁰

Damage arising from such collisions can be considerable. Although the relative velocity at the moment of impact may vary from near zero to very high speeds, typically it is of the order of about 500 km/h if the inclinations of the orbits are 1-2°, and double that value for inclinations around 5°.⁵¹ A collision at 10 km/s would eject from a satellite 115 times the mass of the impacting debris.⁵² With present-day tracking technology, it is possible to detect debris of about 10 cm size in low orbits⁵³ and pieces of 1 m size in the geostationary orbit.⁵⁴

The average lifetime of a geostationary satellite is about ten years.⁵⁵ As of December 31, 1982, there were already at least 41 inactive satellites and 20 non-functional objects in the geostationary orbital belt, besides the active population of 108 satellites.⁵⁶ Not only near-miss situations,⁵⁷ but also some recent malfunctions of satellites have been ascribed to collisions with space debris, one of them involving a geostationary space object.⁵⁸ At present, the probability of damage to a satellite lies in the range of 1-10% for a 100m sphere in orbit within a period of 1,000 days.⁵⁹ This collision hazard will be even greater for large space structures such as solar power satellites. With an area of up to 100 km² cov-

50. Perek, *supra* note 3, at 404.

51. Physical Nature, *supra* note 7, at 8.

52. Kessler & Cour-Palais, *Collision Frequency of Artificial Satellites: The Creation of a Debris Belt*, 83 J. GEOPHYSICAL RESEARCH 2637 (1978), cited in Perek, *Outer Space Activities versus Outer Space*, PROC. 22ND COLL. ON THE LAW OF OUTER SPACE 283, 284 (1980).

53. Physical Nature, *supra* note 7, at 8. About 3,500 debris objects have been discovered in earth orbit. Escaping radar detection is an unknown quantity of small debris (e.g., nuts, bolts, etc.) that may do serious harm to a satellite in a collision. See *supra* note 52.

54. Physical Nature, *supra* note 7, at 8.

55. See *id.* at Annex, Tables 1-3 (surveys of geostationary space stations and their periods of validity). See also C. CHRISTOL, *supra* note 3, at 548.

56. Physical Nature, *supra* note 7, at 3. Another account lists 103 non-functional objects and inactive satellites in geostationary orbit, 56 of which have not been tracked recently. Chobotov, *The Collision Hazard in Space*, 30 J. ASTRONAUTICAL SCIENCES 191 (1982). The differences in enumeration are due to the fact that some non-functioning objects are too small for detection or either have never transmitted signals or have ceased signalling. Physical Nature, *supra* note 7, at 3.

57. In May 1980, it was estimated that FLTSATCOM-1 and IMEWS-4, both U.S. military satellites, would pass close to each other. The predicted miss distance was given as 9.4 km, then reduced a few days later to 3.5 km. Uncertainty in the estimates exceeded the predicted miss distances by 10 km and 20 km respectively, and FLTSATCOM-1 had to undertake evasive maneuvers to escape collision. Johnson, *The Crowded Sky*, 24 SPACEFLIGHT 446 (1982).

58. This object was the European Space Agency's GEOS-2 satellite, the solar panels of which were damaged. Wrenn, *Geos 2 in Space Collision?*, 274 NATURE 631 (1978). Collision with space debris might also have been the cause of malfunction of Cosmos 954. Sedov, *Cosmos 954*, 20 SPACEFLIGHT 184 (1978). A recent U.N. Study lists serious damage to "several" satellites outside the geostationary orbit as probably caused by space debris. Physical Nature, *supra* note 7, at 8.

59. Perek, *supra* note 52, at 284.

ered by them, they would suffer one collision on the average of every five years — a factor of significance, since their projected lifetime is thirty years.⁶⁰

In addition to this danger of physical collision of spacecraft, there is another factor limiting the use of the geostationary orbit: spectrum scarcity. Very few satellites, and virtually none in geostationary orbit, can perform any meaningful function without communication links with one or more ground stations; for some satellites, communications are the sole reason for their existence.⁶¹ The availability of radio frequencies is limited, however, by the need to avoid interference with or by other signals. Regulation of the radio frequency spectrum⁶² is of prime inclusive concern.⁶³ Since the Washington Conference of 1927⁶⁴, the ITU has been empowered to coordinate the use of frequencies to avoid harmful interference⁶⁵ between participants transmitting on the same or adjacent parts of the spectrum.⁶⁶

The ITU's regulatory activity, sometimes called its "legislative process,"⁶⁷ takes place in three steps. First, a number of potential uses or applications of the spectrum representing competing demands, the so-called "radiocommunication services,"⁶⁸ are identified. Then, the organ-

60. Perek, *supra* note 3, at 404-405.

61. *Id.* at 405.

62. Radio frequency is measured in Hertz (Hz), the number of cycles of a radio wave that pass a fixed point within one second. Theoretically, the electromagnetic spectrum runs from 0 Hz to infinity. The part of the spectrum usable for telecommunications, as determined by the ITU, ranges only from 3,000 Hz (3 kHz) to 3,000 billion Hz (3,000 GHz). This radio spectrum is divided into nine frequency bands, ranging in decimal steps from 3-30 kHz up to 300-3,000 GHz. WARC 1979, *supra* note 2, Radio Regulations, no. 208, at 49. The term "frequency band", however, is also used to denote the exact range of frequencies allocated to a specific communication service. *Id.*, Table of Frequency Allocations, nos. 437-443, especially no. 438, at 65.

63. The possibility of interference has necessitated coordination of use since the invention of the electric telegraph in 1835. It is not a matter of chance that the ITU, created in 1865 as the International Telegraph Union, has been the first international organization of universal character. See Noll, *International Telecommunication Union*, 5 ENC. PUB. INT'L L. 177-78 (1983).

64. Rothblatt, *ITU Regulation of Satellite Communication*, 18 STAN. J. INT'L L. 1, 3 (1982).

65. "Interference" has been defined by the ITU as the "effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information. . ." WARC 1979, *supra* note 2, Radio Regulations no. 160, at 46. Regarding interference with transmissions to and from geostationary satellites, see Jeruchim, *A Survey of Interference Problems and Applications to Geostationary Satellite Networks*, 65 PROC. INST. ELECTRICAL & ELECTRONICS ENGINEERS 317 (1977).

66. International Telecommunication Convention of October 25, 1973, 28 U.S.T. 2495, T.I.A.S. No. 8572, art. 35 (hereinafter cited as ITC).

67. D. LEIVE, *INTERNATIONAL TELECOMMUNICATIONS AND INTERNATIONAL LAW: THE REGULATION OF THE RADIO SPECTRUM* 19 (1970).

68. A "radiocommunication service" is defined as "involving the transmission, emission

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ization's world administrative radio conferences (WARCs) will *allocate* specific frequency bands to these services.⁶⁹ This distribution is published in the ITU's Table of Frequency Allocations. In a second phase, plans may be drawn up, at regional or specific world administrative radio conferences, by virtue of which frequency channels are *Allotted* to individual countries or groups of countries for use for the services specified.⁷⁰ Finally, states *assign* frequencies or channels to their domestic applicants, individual radio stations.⁷¹

These assignments must be reported to the ITU. Within that organization, the International Frequency Registration Board (IFRB) — a committee of five members with the constitutional mandate, not to represent their home countries or regions, but to act as "custodians of an international public trust"⁷² — is empowered to examine the national notice, correspond with the notifying state, issue findings with regard to conformity to existing prescriptions, state the possibility that a noticed frequency would produce harmful interference with previously recorded assignments, and formulate recommendations in such a situation, as well as finally record the assignment in the Master International Frequency Register.⁷³ Conflicts between old users of a frequency and prospective new ones are decided in favor of the first to notify and to use the contested part of the spectrum⁷⁴ in accordance with ITU prescriptions. The ITU's Radio Regulations state that only this assignment enjoys the

and/or reception of radio waves for specific telecommunication purposes." WARC 1979, *supra* note 2, Radio Regulations no. 20, at 33. The Regulations list 37 such services, including broadcasting, radionavigation, fixed and mobile uses and uses in space. *Id.*, Radio Regulations no. 20-57, at 33-36.

69. "Allocation" is defined as "[e]ntry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio-astronomy service under specified conditions." *Id.*, Radio Regulations no. 17, at 33.

70. "Allotment" is the "[e]ntry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a radiocommunication service in one or more identified countries or geographical areas and under specified conditions." *Id.*, Radio Regulations no. 18, at 33.

71. "Assignment" is defined as the "[a]uthorization given by an administration for a radio station to use a radio frequency channel under specified conditions." *Id.*, Radio Regulations no. 19, at 33.

72. ITC, *supra* note 66, art. 10(2).

73. WARC 1979, *supra* note 2, Radio Regulations nos. 990-1006, at 159-60. See also C. CHRISTOL, *supra* note 3, at 553; Rothblatt, *supra* note 64, at 4.

74. Rothblatt, *supra* note 64, at 3-4; Rutkowski, *The 1979 World Administrative Radio Conference: The ITU in a Changing World*, 13 INT'L LAW. 289, at 307 (1979). See also D. SMITH, *INTERNATIONAL TELECOMMUNICATION CONTROL* 30 (1969) ("frequencies are still assigned on a time priority basis rather than based on equitable principles"). For a somewhat different view, see D. LEIVE, *supra* note 67, at 23 ("In many disputes first use of a frequency is not a controlling factor, and often is not even relevant to a determination of the respective rights of the parties concerned."). See also C. CHRISTOL, *supra* note 3, at 555-68.

"right to international protection from harmful interference"⁷⁵ New users thus have to "engineer their systems around the earlier ones"⁷⁶ or seek agreement with existing users. The latter have to accommodate the newcomer only to the extent that "such change is acceptable to administration or administrations concerned,"⁷⁷ which leaves control over the frequency in their hands. This doctrine of prior notification⁷⁸ is summarized in the slogan "first-come, first-served."⁷⁹

Inclusive legislative processes with respect to space communications started the same way: with the definition of several types of space services⁸⁰ and the allocation of frequency bands in which these services could operate. However, in contrast to the quiet world one century ago, satellite communications entered an environment "deeply immersed in a cacophony of electronic communications."⁸¹ Optimal satellite frequencies, from around 1 to 10 GHz, were already allocated among several terrestrial services. Thus, frequency sharing between satellite and terrestrial users was introduced by the 1963 extraordinary Administrative Radio Conference for Space.⁸² The IFRB was entrusted with coordination of such simultaneous use of radio waves.⁸³ Nevertheless, the traditional "first in time, first in right" rule of international communications law still prevailed.⁸⁴

75. WARC 1979, *supra* note 2, Radio Regulations no. 1416, at 199. Such frequency assignments are entered in Column 2a ("Registration") of the Master Register. However, the IFRB's "quasi-judicial" authority is rather limited. D. LEIVE, *supra* note 67, at 20. If a state insists that a noticed frequency assignment be recorded, even though it contravenes ITU prescriptions and/or will interfere with previously recorded uses, the IFRB must do so. However, it will be entered only in Column 2b ("Notification"), "in order that administrations may take into account the fact that the frequency assignment concerned is in use." In general, this recording "shall not give the right to international protection to the frequency assignment concerned. . . ." WARC 1979, *supra* note 2, Radio Regulations no. 1417, at 200.

76. Jackson, *The Allocation of the Radio Spectrum*, 242 SCI. AM. 34, at 38 (1980).

77. WARC 1979, *supra* note 2, Radio Regulations no. 1449, at 203.

78. Ickowitz, *The Role of the International Telecommunication Union in the Settlement of Harmful Interference Disputes*, 13 COL. J. TRANSNAT'L L. 82, 87 (1974).

79. Valters, *supra* note 49, at 76-77.

80. 18 of the 37 communication services identified by ITU in its latest Radio Regulations are space-related: the Fixed-Satellite Service, the Inter-Satellite Service, the Space Operation Service, the Mobile-Satellite Service, the Land Mobile-Satellite Service, the Maritime Mobile-Satellite Service, the Aeronautical Mobile-Satellite Service, the Broadcasting-Satellite Service, the Radiodetermination-Satellite Service, the Radionavigation-Satellite Service, the Maritime Radionavigation-Satellite Service, the Aeronautical Radionavigation-Satellite Service, the Earth Exploration Satellite Service, the Meteorological Satellite Service, the Standard Frequency and Time Signal-Satellite Service, the Space Research Service, the Amateur-Satellite Service, and the Radio Astronomy Service. WARC 1979, *supra* note 2, Radio Regulations nos. 21-57, at 33-36.

81. Rothblatt, *supra* note 64, at 5.

82. *Id.* at 5-6.

83. *Id.* at 6; D. LEIVE, *supra* note 67, at 228-34.

84. A. CHAYES, *SATELLITE BROADCASTING* 18 (1973). ITU Secretary-General Mili stated in 1968 that "[t]he ITU will certainly continue in the future to deal with satellite links as

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This began to change with a series of ITU conferences in the 1970's. The first one, the World Administrative Radio Conference on Space Telecommunications (WARC-ST) of 1971, established that first use and registration did not give rise to any "permanent priority."⁸⁵ The 1973 Plenipotentiary Conference, rewriting the International Telecommunication Convention, declared space services and the geostationary orbit to be "limited natural resources," to which access should be provided on an equitable basis.⁸⁶ Furthermore, the IFRB was entrusted with another function, to "effect . . . an orderly recording of the positions assigned by countries to geostationary satellites. . . ."⁸⁷ Thus, a direct link was established between frequency assignments and orbital positions occupied by spacecraft having the capacity to make use of such frequencies, mainly with the argument that it is "impossible to consider separately" the orbit and the spectrum resource.⁸⁸ In a drive for equitable access, frequencies and "nominal orbital positions"⁸⁹ were assigned⁹⁰ to individual countries for use in the Broadcasting-Satellite Service⁹¹ at ITU conferences in 1977, 1979, and 1983.⁹² Planning of further space services is envisioned for the 1985-88 World Administrative Radio Conference on the Use of the Geostationary Orbit.⁹³

This intense inclusive concern along with new technologies reduced the specific constraints on the use of the geostationary corridor due to spectrum scarcity. Up until very recently, it was believed that satellites

it has done in the past for other means of telecommunication." 35 ITU TELECOMM. J. 240 (1968).

85. Final Acts of the World Administrative Radio Conference for Space Telecommunications of July 17, 1971, Resolution Spa 2-1, 23 U.S.T. 1527, 1820, T.I.A.S. No. 7435 (hereinafter cited as WARC-ST).

86. ITC, *supra* note 66, at art. 33(2).

87. *Id.*, at art. 10(3)(b).

88. Thus the physical space resource and the radio spectrum are lumped together into the "nominal orbit/spectrum" in Butler, *World Administrative Radio Conference for Planning Broadcasting Satellite Service*, 5 J. SPACE L. 93 (1977). The author is the Secretary-General of the ITU.

89. This term is defined in ITU's Radio Regulations as the "longitude of a position in the geostationary-satellite orbit associated with a frequency assignment to a space station in a space radiocommunication service. The position is given in degrees from the Greenwich meridian." WARC 1979, *supra* note 2, Radio Regulations, Appendix 30, Annex 8, no. 1.4, at 665.

90. Correct use of this term is questioned by Christol, since entry of designated frequency channels in a plan for use by "administrations," i.e., member states, is "allotment" under ITU regulations. C. CHRISTOL, *supra* note 3, at 600 n. 102.

91. The term is defined as a "radiocommunication service in which signals transmitted or retransmitted by space stations are intended for direct reception by the general public." WARC 1979, *supra* note 2, Radio Regulations no. 37, at 35.

92. Final Acts, World Administrative Radio Conference for the Planning of the Broadcasting-Satellite Service in Frequency Bands 11.7-12.2 GHz (in Regions 2 and 3) and 11.7-12.5 GHz (in Region 1), 1977 (hereinafter cited as WARC-BS), reprinted in WARC 1979, *supra* note 2, Appendix 30, at 605; SAT-83, *supra* note 45.

93. WARC 1979, *supra* note 2, Resolution BP, at 744.

had to be placed at a distance of 4° from one another to avoid interference, if they transmitted on the same frequency. With only two frequencies available, a 2° separation between neighboring satellites was said to be required. This factor would have narrowed the number of satellites capable of accommodation in the geostationary orbit to 180.⁹⁴

However, further frequency bands were allocated to space services at WARC 1979.⁹⁵ For the broadcasting-satellite service alone, the 1977 WARC-BS assigned frequencies for 162 space stations at 36 positions in the orbit.⁹⁶ The 1983 Regional Plan for the Americas accommodated 2,058 space stations at 48 closely spaced orbital positions by judiciously using technical means such as cross-polarization, assignment to adjacent satellites of widely separated service areas, proper choice of channels, and minimization of spatial separation between satellites.⁹⁷ It may be impossible to determine the maximum number of geostationary satellites by reference to spectrum scarcity.⁹⁸ However, the self-interest of nations in reliable communications free from interference will continue to favor inclusive regulation of the spectrum, and thus limit access to space communications frequencies which are, in turn, conditions *sine qua non* for the use of the geostationary orbit. Finally, besides the collision hazard and spectrum scarcity, other man-made and natural interferences with the functions of satellites limit the use of this precious resource.

Twice a year, for four consecutive days, a satellite appears to pass so close to the solar disc that communications are interrupted. This solar

94. E. HERTER & H. RUPP, *supra* note 10, at 22-23; von Kries, *The Legal Status of Geostationary Orbit - Introductory Report*, PROC. 18TH COLL. ON THE LAW OF OUTER SPACE 27, 31 (1975); Busak, *Geostationary Satellites and the Law*, 39 ITU TELECOMM. J. 487 (1972); Gibbons, *supra* note 6, at 147.

95. Frequency allocations for space services in the MHz and GHz ranges were already made at the 1971 WARC-ST. See C. CHRISTOL, *supra* note 3, at 558. Regarding allocations at the WARC 1979, see Gorove, *The World Administrative Radio Conference 1979: Some Legal and Political Implications*, 29 ZEITSCHRIFT FÜR LUFT- UND WELTRAUMRECHT 214 (1980).

96. *Physical Nature*, *supra* note 7, at 4.

97. See *The Regional Broadcasting-Satellite Conference for the Americas*, 50 ITU TELECOMM. J. 438, 439 (1983). See also SAT-83, *supra* note 45. In ITU language, the term "space station" is not identical to "satellite." A space station is a station (one or more transmitters or receivers or a combination of transmitters and receivers) located on an object which is beyond, is intended to go beyond, or has been beyond, the major portion of the earth's atmosphere. See WARC 1979, *supra* note 2, Radio Regulations no. 61, at 37. A satellite is a "body which revolves around another body of preponderant mass and which has a motion primarily and permanently determined by the force of attraction of that other body." *Id.*, Radio Regulations no. 171, at 47. Several space stations, in other words, may be located on a single satellite, provided the uses are compatible. *Physical Nature*, *supra* note 7, at 2; Perek, *supra* note 3, at 412. The main policy underlying the 1983 DBS Plan for the Americas has been "clustering" satellites at nominal orbital positions within 0.4° -wide ranges of the orbital arc. SAT-83, *supra* note 45, at art. 3.3, Part I, p.2.

98. *Physical Nature*, *supra* note 7, at 4; see also Technical Bases, *supra* note 5, Part II, at 195-202.

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outage lasts for up to six minutes. Another source of involuntary pauses of transmission is shadowing, i.e. the occultation of the sun by other objects. Most satellites are operated with solar energy backed up by batteries. If occultation of the sun cuts off this source of power for a longer period than that for which the batteries had been designed, the functions of the spacecraft will be interrupted. The earth can eclipse the sun for 72 minutes on the days of the vernal and autumnal equinoxes.⁹⁹ The moon eclipses the sun very rarely, and for only one minute.¹⁰⁰

The shadow thrown by other satellites is more than 100 times larger than their dimensions. This will present serious problems with the advent of large space structures. A 20 km solar power station, for example, will throw a shadow extending over 2,000 km, a length corresponding to almost 3° of longitude on the orbital arc.¹⁰¹

This cursory review of satellite technology and spectrum management leads to four conclusions:

1. The geostationary orbit is not a unitary resource in fixed supply, but a composite resource made up of a physical space (satellites' orbital locations) and an electromagnetic spectrum element (frequencies).¹⁰² It has dimensions of place, time, bandwidth, and strength.
2. This resource is finite, but non-depleting. It is used, not consumed, and it is wasted when it is not used.¹⁰³ Inactive satellites' frequencies can be taken over by other space stations immediately after transmissions end. Spacecraft can be removed from geostationary orbit,¹⁰⁴ thus releasing their slot for potential successors.
3. In certain more popular parts of the orbit, the radio spectrum is

99. Perek, *supra* note 3, at 405-06. Because of this lack of illumination of solar cells during equinoctial eclipses, broadcasting satellites are situated further to the west than the region to be served. Thus, satellites servicing Europe are stationed above the Atlantic, where they presented problems of interference with stations in the Americas, particularly Brazil. Interregional coordination procedures had to be applied. C. CHRISTOL, *supra* note 3, at 571.

100. Perek, *supra* note 3, at 406.

101. Perek, *supra* note 52, at 285.

102. See Wihlborg & Wijkman, *Outer Space Resources in Efficient and Equitable Use: New Frontiers for Old Principles*, 24 J. L. & ECON. 23, 28 (1981).

103. See, as to the spectrum element, JOINT TECHNICAL ADVISORY COUNCIL OF THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS AND THE ELECTRONIC INDUSTRIES ASSOCIATION, *RADIO SPECTRUM UTILIZATION: A PROGRAM FOR THE ADMINISTRATION OF THE RADIO SPECTRUM* 3-6 (1965), cited in D. LEIVE, *supra* note 67, at 15-16.

104. There are three ways to remove satellites from geostationary orbit: (1) pushing the spacecraft into the earth's atmosphere, (2) pushing it out of the earth's gravitational field, and (3) placing it in a disposal orbit. All this could be done by using up the craft's last energy resources. For the conditions under which each method would be most efficient and economical, see *Study on the Dynamics of Space Objects*, Committee on the Peaceful Uses of Outer Space, U.N. Doc. A/AC.105/259, at 12-19 (1980). Inactive drifting space objects pose serious threats to active satellites. See *supra* notes 48-60 and accompanying text.

already congested; this is true, in particular, for the 6/4 GHz band pair used on nearly all commercial networks providing point-to-point communications, such as telephony, television, teleconferencing and data transmission. The next band pair approaching congestion is 14/11-12 GHz.¹⁰⁵ As of December 31, 1982, there were 169 space objects in the geostationary orbital lane, of which no more than 108 were active.¹⁰⁶ The number of geostationary satellites has increased by 18% annually over the last decade.¹⁰⁷ It is estimated that a total of 330 satellites will crowd the corridor by 1990.¹⁰⁸ Besides the Indian Ocean, problems are particularly pressing in the orbit segments above the Americas and the Atlantic Ocean.¹⁰⁹

4. For some purposes, use of geostationary orbit is indispensable. For others, it may be only convenient, and the same results can be reached by using other orbits¹¹⁰ or terrestrial resources.¹¹¹ In these latter cases, processes of substitution will occur.

The ITU has called the geostationary orbit a "limited natural resource." Controversies about whether both adjectives are borne out by the facts¹¹²

105. Technical Bases, *supra* note 5, Part I, at 22 and Part II, at 32-34 (need for "complex and costly" coordination processes).

106. Physical Nature, *supra* note 7, at 3. On the same day, the ITU reported 243 space stations, of which 83 had been registered, 92 were in the coordinating process under the relevant Radio Regulations, and 68 were advance publications by member states. *Id.* at 4.

107. U.N. Chronicle, *supra* note 12, at 58.

108. Christol, *International Space Law and the Use of Natural Resources: Solar Energy*, 15 REVUE BELGE DE DROIT INT'L 28, 30 (1980).

109. These are the only ones suitable for broadcasting, telephone and other communications in and between the United States and Europe, for such satellites require a direct line of sight to the area they serve. First users of solar power stations probably will also be the highly industrialized nations of the West, thus further increasing congestion on this part of the orbit. Gibbons, *supra* note 6, at 147. Evidence of scarcity is abundant. In an interoffice memorandum of March 10, 1980, the FCC Chief of Satellite Systems Branch reported that "satisfactory orbit locations cannot be found for all existing or soon-to-be-filed applications." Note, *Communication Satellites and the Geostationary Orbit: Reconciling Equitable Access with Efficient Use*, 14 L. & POL'Y IN INT'L BUS. 859, 879 (1982). On April 24, 1980, the FCC closed the door on filings for domestic satellite systems, citing, *inter alia*, the unavailability of orbital locations. See Rothblatt, *supra* note 64, at 8.

110. Remote sensing and a variety of other scientific satellites are already operating in other orbits for the most part. See *supra* note 27 and accompanying text. They do not contribute significantly to the congestion of the geostationary orbit, nor do the four or five meteorological satellites which suffice to provide coverage for the whole planet. The major use of the geostationary orbit is for communications satellites; alternative orbits for them include eccentric 12-hour and 24-hour orbits. Physical Nature, *supra* note 7, at 5-7; see also Technical Bases, *supra* note 5, Part I, at 9-17, and Part II, at 32-71, reporting the degree of use of the geostationary orbit by the various space services.

111. Increased use of fiber-optic technology could make terrestrial lines, in particular transoceanic cables, attractive substitutes for satellites.

112. Pointing to the fact that an orbital slot is reusable after the death and removal of a satellite, Kosuge has questioned the appropriateness of calling the geostationary orbit a "lim-

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shrink into scholastic insignificance before the need to devise ways and means to prevent this scramble for ever-fewer "places in the sun" from bursting into open violence. Beyond its impact on national economies,¹¹³ this resource has become vital to the world social process and of ever-increasing importance to the value processes of individuals and territorial communities.¹¹⁴ It is imperative to build the public order of the geostationary orbit.

II. Claims Relating to the Geostationary Orbit

Law does not arise automatically from technical necessities as perceived by an orderly mind. It is not a static body of rules enshrined in treaties, statutes, and textbooks. Law is a continuing process of interaction in which, at the global level, decision-makers of individual territorial communities unilaterally put forward claims such as those relating to the use of the geostationary corridor. The claims of these elites are often conflicting and mutually exclusive, and other decision-makers, external to the demanding state and including both national and international officials, weigh and appraise these competing claims in light of the interests of the world community and the identity and base values of the rival

ited resource." Kosuge, *National Appropriation of Geostationary Satellite Orbit*, PROC. 21ST COLL. ON THE LAW OF OUTER SPACE 31, 33 (1979). However, there is always some limit to the number of satellites that can occupy the orbit at any given time. See Rosenfield, *Solar Energy and the "Common Heritage of Mankind"*, PROC. 21ST COLL. ON THE LAW OF OUTER SPACE 58, 63 (1979). Space-resource states have taken pains to explain that orbital slots are not totally natural phenomena. C. CHRISTOL, *supra* note 3, at 455. This truism tends to overshadow the fact that the major cause for the geostationary effect is the attraction of the total mass of the earth. See *supra* notes 3, 5. Only in theory could an "artificial" geostationary satellite be created through the use of strong station-keeping propulsion in some alternate orbit. In practice the fuel expenditure would be prohibitive. Perek, *supra* note 3, at 402.

113. A 1982 congressional study states that "within a single generation the communication and information industry has become one of the most vital in the world." The United States has a 45 % share of the world market for telecommunication electronics and computer equipment which is estimated at \$250 billion per year, with an annual growth rate of 10-15%. Worldwide revenues from telecommunication services alone exceeded \$170 billion in 1980. Net income for major communication carriers has grown in recent years, and potential investors are anxious to invest in satellite hardware. U.S. CONGRESS OFFICE OF TECHNOLOGY ASSESSMENT, *RADIOFREQUENCY USE AND MANAGEMENT: IMPACTS FROM THE WORLD ADMINISTRATIVE RADIO CONFERENCE OF 1979* 28 (1982). See also *Buyers and Sellers in Space*, THE ECONOMIST, Nov. 21, 1981, at 96; Menter, *Commercial Participation in Space Activities*, 9 J. SPACE L. 53 (1981); Smith & Rothblatt, *Geostationary Platforms: Legal Estates in Space*, 10 J. SPACE L. 31 (1982).

114. Its use is becoming critically important for all the values described in H. LASSWELL & A. KAPLAN, *POWER AND SOCIETY* (1950) and in Lasswell & Holmberg, *Toward a General Theory of Directed Value Accumulation and Institutional Development*, in COMPARATIVE THEORIES OF SOCIAL CHANGE 12 (1966): enlightenment (scientific exploration), skill (technical accomplishments), well-being (broadcasting, search and rescue missions), respect (dissemination of information by DBS), rectitude (cultural and religious transmissions), affection (trans-frontier broadcasting, individual communications), but in particular wealth (communications industry, remote sensing, solar energy), and power (military activities).

claimants, and ultimately accept or reject them. "As such a process, it is a living, growing law, grounded in the practices and sanctioning expectations of nation-state officials, and changing as their demands and expectations are changed by the exigencies of new interests and technology and by other continually evolving conditions in the world arena."¹¹⁵

Two conclusions can be drawn from this. First, law is essentially a matter of choice. Prescriptions do not flow, like the laws of natural science, from immutable experience and observation. Kepler's laws are but factual limits, objective ramifications of the bulk of highly flexible rules designed to guide human behavior. Often, these rules are inherited; sometimes, they are fairly novel, like the general public order of outer space. Always, they are subject to change.

Second, resource control and exploitation are subject to various regimes, or public orders, which have developed over time in the process of continuous interaction as outlined above. The regimes differ according to the nature of the resource, the conditions necessary for its optimum use, including its conservation, and the prevailing socio-economic context. Common interests may be furthered by allocating competence "exclusively," i.e. by reserving use for a single state, or "inclusively," i.e. in ways that include the entire community.¹¹⁶ Thus "sectoral world orders"¹¹⁷ have emerged, differing *ratione materiae* as well as *temporis*.

The composite resource of the geostationary orbit, as defined above, constitutes—like land, air, water, minerals, and plants, and human resources—a critical variable and important base value in the world social process.¹¹⁸ Claims to its control and use can be arranged on a sliding scale from intense exclusive control to the most extreme forms of shared, inclusive competence.

A. Claims to Exclusive Control Over the Geostationary Orbit

On December 3, 1976, eight equatorial countries¹¹⁹ proclaimed their

115. McDougal, *The Hydrogen Bomb Tests and the International Law of the Sea*, 49 AM. J. INT'L L. 356, 357 (1955). See also Almond, *A Public Order in Outer Space for Peaceful Purposes: The Will of the World Community and the Constitutive Process*, PROC. 22ND COLL. ON THE LAW OF OUTER SPACE 83 (1980).

116. M. McDUGAL & W. REISMAN, *supra* note 37, at 432-34.

117. Graf Vitzthum, *The Search for Sectoral World Orders*, ASPEKTE DER SEERECHTS-ENTWICKLUNG 273 (W. Graf Vitzthum ed. 1980).

118. M. ARSANJANI, INTERNATIONAL REGULATION OF INTERNAL RESOURCES: A STUDY OF LAW AND POLICY 3 (1981).

119. Colombia, Congo, Ecuador, Indonesia, Kenya, Uganda, and Zaire; Brazil sent an observer. Gabon and Somalia later joined the Declaration. Galloway, *The Current Status of the Geostationary Orbit*, PROC. 21ST COLL. ON THE LAW OF OUTER SPACE 22 (1979). The other two equatorial members of the U.N. are Peru and Nauru. C. CHRISTOL, *supra* note 3, at 466.

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"national sovereignty" over the segments of the geostationary orbit lying above their respective territories. In the basic communique, the Declaration of Bogotá, this vertical extension of exclusive competency is justified by reference to astrophysics:

Equatorial countries declare that the geostationary synchronous orbit is a physical fact linked to the reality of our planet because its existence depends exclusively on its relation to gravitational phenomena generated by the earth, and that is why it must not be considered part of the outer space.¹²⁰

This argument is joined by a reference to United Nations resolutions on permanent sovereignty of peoples and nations¹²¹ and/or states¹²² over their wealth and natural resources. Qualification of the geostationary orbit as such a natural resource, however, would not, by itself, allocate it to a discrete territorial community. Thus the claim basically is one founded on contiguity, an age-old mode of acquisition or myth invoked to condone extensions of exclusive control.¹²³

The consequences drawn from this claim are stated clearly:

The devices to be placed permanently on the segment of a geostationary orbit of an equatorial state shall require previous and expressed authorization on the part of the concerned state, and the operation of the device should conform with the national law of that territorial country over which it is placed. . . . Equatorial countries do not condone the existing satellites or the position they occupy on their segments of the Geostationary Orbit nor does the existence of said satellites confer any rights of placement of satellites or use of the segment unless expressly authorized by the state exercising sovereignty over this segment.¹²⁴

Article II of the 1967 Outer Space Treaty,¹²⁵ prohibiting national appropriation of outer space, was swept away with the argument that lack of definition of its scope of application *ratione loci* implies that it "should not apply to the geostationary orbit. . . ."¹²⁶ Even if this orbit were

120. Declaration of Bogotá 2, 15 REVUE BELGE DE DROIT INT'L 48, AT 49 (1980).

121. Declaration of Bogotá, *supra* note 120, at 50, referring to G.A. Res. 2692, 25 U.N. GAOR Supp. (No. 28) at 63, U.N. Doc. A/8028 (1971) (Permanent sovereignty over natural resources of developing countries and expansion of domestic sources of accumulation for economic development).

122. Declaration of Bogotá, *supra* note 120, at 5, referring to the Charter of Economic Rights and Duties of States, G.A. Res. 3281, 29 U.N. GAOR Supp. (No. 31) at 50, U.N. Doc. A/9631 (1974).

123. See D. SCHENK, KONTIGUITAT ALS ERWERBSTITEL IM VOLKERRECHT (1978). Effective occupation of a *res nullius* could not possibly have been asserted, because only one participant, Indonesia, has actually placed satellites in orbit.

124. Declaration of Bogotá, *supra* note 120, at 51.

125. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, of January 27, 1967. 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205 (hereinafter cited as 1967 Treaty).

126. Declaration of Bogotá, *supra* note 120, at 52.

covered by the Treaty, Article II could not:

be considered as a final answer to the problem of the exploration and use of outer space, even less when the international community is questioning all the terms of international law which were elaborated when the developing countries could not count on adequate scientific advice and were thus not able to observe and evaluate the omissions, contradictions and consequences of the proposals which were prepared with great ability by the industrialized powers for their own benefit.¹²⁷

In any event, the Bogotá signatories claimed that the current users were in violation of this provision, for: "Under the name of a so-called non-national appropriation, what was actually developed was technological partition of the orbit, which is simply a national appropriation. . . ."¹²⁸

The Bogotá states tried to press their claims in inclusive arenas. Thus, within the framework of UNCOPUOS, they presented the geostationary orbit as a "limited national resource" of a *sui generis* character, in which satellites could be placed only with the consent of the underlying states.¹²⁹

Within the framework of the ITU, six of the eight original signatories of the Bogotá Declaration¹³⁰ and Gabon added a reservation to the Final Acts of the 1977 WARC-BS stating that they were not bound by conference decisions regarding the location of satellites in segments of the orbit over which they claimed sovereign rights. They reiterated their view that use of such positions would require prior consent of the subjacent state, and "reserved the right" to take steps to preserve and secure observance of their rights.¹³¹ At the 1979 WARC, similar protocols were filed by eight equatorial states.¹³²

The latest statements by representatives of the equatorial states, however, carefully avoid references to their national sovereignty over the geostationary orbit and to the requisite of prior consent. They now seem to favor inclusive planning of the resource, allowing for a regime of equitable access to the orbit which should take into account the needs of the developing countries and "the special interests of the equatorial na-

127. *Id.* at 51.

128. *Id.*

129. See Report of the Legal Sub-Committee on the Work of its Twentieth Session (16 Mar.-10 Apr. 1981), Committee on the Peaceful Uses of Outer Space, U.N. Doc. A/AC.105/288, at II (1981).

130. Colombia, Congo, Ecuador, Kenya, Uganda, and Zaire.

131. WARC-BS, *supra* note 92, Doc. 331-E. See C. CHRISTOL, *supra* note 3, at 462.

132. Somalia joined the states listed *supra*, note 130. Indonesia filed a "separate, but supportive" statement. C. CHRISTOL, *supra* note 3, at 603 n.152.

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tions."¹³³ This return to the fold of the Group of 77 was somewhat shadowed in paragraph 3a of the Bogotá Declaration, which read:

The sovereign rights put forward by the equatorial countries are directed towards rendering tangible benefits to their respective people and for the universal community, which is completely different from the present reality when the orbit is used to the greater benefit of the most developed countries."¹³⁴

Claims to exclusive control over the geostationary orbit are thus for the moment in abeyance, pending the creation of a more inclusive regime for allocating orbital positions.

B. Claims to Unrestricted Use of the Geostationary Orbit

Highly developed countries are the predominant users of the geostationary orbit. Of the 74 communications satellites in this corridor at the end of 1982, only 4 had been launched by or for developing countries.¹³⁵ At the time of the 1979 WARC, it was observed that 90 % of the radio spectrum was controlled by countries with only 10 % of the world's population.¹³⁶ These "space-resource states"¹³⁷ vigorously fought for the

133. Mr. Sunaryo (Indonesia), at a recent session of UNCOPUOS, stressed his government's aim to develop:

the right planning methods and arrangements in the use of the geostationary orbit, ones which would guarantee its fair and proper utilization. . . . Since the geostationary orbit has a *sui generis* character, the promulgation of legal norms regulating its use should not fall under the regime of the 1967 Outer Space Treaty, and should take into account the needs of the developing countries and the special interests of the equatorial nations. Committee on the Peaceful Uses of Outer Space, *supra* note 15, at 58-60.

The Kenyan delegate put it this way:

This delegation cannot accept the *status quo* which bases the present use of the orbit on a first-come-first-served basis. We are of the view that such regulation should take into account not only the character of the resource, but also the fact that equatorial countries have interests in the orbit.

Mr. Wabuge, Committee on the Peaceful Uses of Outer Space, *supra* note 15, at 22-25. Mr. Rodriguez Medina, the representative of the host country to the Bogotá meeting, referred to the "urgent aspiration" by the "overwhelming majority . . . of this Committee" to "legally regulate and technologically plan the use of the geostationary orbit." He trusted that the "technological Powers, in particular the United States, will lift their reservations on this issue and play a full part in work on draft principles to fill one of the biggest gaps and play a full part in the 1967 Outer Space Treaty." Committee on the Peaceful Uses of Outer Space, *supra* note 25, at 18-20. His only reference to the equatorial countries was to their maintaining "for almost 10 years, how only a few technological Powers enjoy monopolistic use of the orbital resource, thanks to a *de facto* appropriation, based on the principle of first come, first served." *Id.* at 21. See also Moyano, *La Orbita Geostacionaria y el Territorio del Estado*, 249-251 REVISTA DE LA ACADEMIA COLOMBIANA DE JURISPRUDENCIA 48-68 (July-Dec. 1982).

134. Declaration of Bogotá, *supra* note 120, at 50.

135. Physical Nature, *supra* note 7, at 3. Since then, the two third-world space powers, India and Indonesia, have each deployed a third satellite in geostationary orbit.

136. Hudson, *Implications for Development Communications*, 29 J. COM. 179, 181 (1979). See also Bortnick, *International Information Flow: The Developing World Perspective*, 14 CORNELL INT'L L. J. 333, 349 (1981).

freedom of outer space, as applied to the geostationary orbit. They rejected the Bogotá claims¹³⁸ as well as inclusive regulation by UN-COPUOS, there being, in the words of the U.S. delegate: "no practical question concerning the geostationary orbit, which is clearly in outer space, that can be answered or indeed appropriately addressed by the development of new legal norms outside the ITU context."¹³⁹

Within the ITU context, the traditional approach to registration and coordination of frequencies and orbital positions was favored over a framework of comprehensive allotments of frequencies and orbital positions prior to their use. The U.S. position was stated prior to the 1979 WARC as follows:

The United States remains committed to the present system of flexible procedures, although we recognize that there is room for simplification and improvement in the application of these procedures. We are generally opposed to prefixed allotment plans which distribute frequencies to individual countries or regions without regard to present or demonstrated foreseeable need.¹⁴⁰

It was argued that the doctrine of prior notification had the advantages of low cost and simplicity and required only minimal disclosure of information.¹⁴¹ This a posteriori approach was also hailed as providing a flexible framework on the basis of which states might seek suitable accommodation, depending on needs at any given time.¹⁴² Trusting that technological progress will allow expanded use of the orbit, developing countries' fears were regarded by the highly developed states as unfounded. The United States even sought "to provide reliable assurance to all nations that they can obtain access to the spectrum as and when their requirements develop."¹⁴³ Thus, the United States preferred to

137. "The space-resource States have vigorously identified their preference for free and equal exploration, use and exploitation of and free access to outer space." C. CHRISTOL, *supra* note 3, at 457. Haanappel in 1978 expressly mentioned as states capable of putting satellites in geostationary orbit only the United States, the U.S.S.R., Canada, France, and West Germany, besides international organizations such as Intelsat and Intersputnik. Haanappel, *Article II of the Outer Space Treaty and the Status of the Geostationary Orbit*, PROC. 21ST COLL. ON THE LAW OF OUTER SPACE 28 n.5 (1979). This group has since expanded.

138. This is true for both the United States and the U.S.S.R. See C. CHRISTOL, *supra* note 3, at 456, 469.

139. Remarks of Mr. Sherman, Committee on the Peaceful Uses of Outer Space, *supra* note 15, at 34-35.

140. U.S. Department of State, Reports Submitted to Congress Pursuant to the Foreign Relations Authorization Act, Fiscal Year 1979 (Public Law 95-426), submitted to the Committee on Foreign Relations, U.S. Senate, and the Committee on Foreign Affairs, U.S. House of Representatives, 96th Cong. 1st Sess. 89 (1979) (hereinafter cited as *Reports*).

141. Jackson, *supra* note 76, at 38.

142. C. CHRISTOL, *supra* note 3, at 569-70. This system would "prevent the allotment of such resources to prospective users unless there were a need for actual use." *Id.* at 570.

143. *Reports*, *supra* note 140, at 89.

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characterize its position as "everyone-come, everyone-served," rather than "first-come, first-served."¹⁴⁴

A priori allotment of frequencies and orbital positions has been perceived by the major present users as preventing optimum use of the orbit. This system would leave many of the allotted frequencies and orbital positions unused, because less developed countries generally lacked facilities, money, or the need to use them.¹⁴⁵ Furthermore, it was argued that allotments to many small states would remove incentives to develop orbit/spectrum-conserving technologies¹⁴⁶ and thus stifle technological progress.¹⁴⁷ On the other hand, a priori planning systems would produce congestion,¹⁴⁸ in particular on the parts of the orbit allotted to space-resource powers. This proposal was labelled "wasteful, inefficient and inequitable."¹⁴⁹ Finally, it was criticized for establishing permanent priorities of use, contrary to Resolution Spa 2-1 of the 1971 WARC-ST.¹⁵⁰

As its policy for the 1983 Regional Administrative Radio Conference on the Broadcasting-Satellite Service for the Americas (RARC-83), the United States thus favored maximum flexibility. Specifically, the FCC's RARC-83 Advisory Committee, "dominated by employees and associates of the major communication service providers,"¹⁵¹ advocated a scheme referred to as "block allotment planning."¹⁵² A nation would be granted one or more orbital slots, a "block" (i.e. a continuous position on the frequency spectrum), and specified service areas. Specific channels could be assigned later in domestic decision-making processes.¹⁵³

In short, claims by highly developed countries to unrestricted use of the geostationary orbit are beginning to give way to somewhat more inclusive schemes, but these countries continue to resist (at least verbally) a comprehensive a priori allotment system.

C. Claims to Organized Inclusive Control Over the Geostationary Orbit

In the 1970s, outer space and telecommunications were drawn into the

144. Robinson, *Regulating International Airwaves: The 1979 WARC*, 21 VA. J. INT'L L. 31 (1980). The author was the Chairman of the United States delegation to the 1979 WARC.

145. See T. MCPHAIL, ELECTRONIC COLONIALISM 159 (1981). See also Gorove, *supra* note 3, at 459-61.

146. C. CHRISTOL, *supra* note 3, at 581.

147. Bortnick, *supra* note 136, at 349.

148. C. CHRISTOL, *supra* note 3, at 587.

149. *Id.* at 570.

150. *Id.* at 588.

151. Note, *supra* note 109, at 874.

152. RARC-83 Advisory Committee, Third Progress Report of Working Group 2B of Subcommittee 2, at 2 (March 3, 1982), cited in Note, *supra* note 109, at 874.

153. Note, *supra* note 109, at 874-75.

larger confrontation between the developed states and the Third World.¹⁵⁴ This confrontation centered on the latter's claims for a "new international economic order,"¹⁵⁵ in which the world's *descamisados* would receive a more equitable share of resources and greater power in the global constitutive process.

The position of the Third World has been stated most clearly before UNCOPUOS by the delegate of Vietnam, Mr. Le Kim Chung:

Viet Nam, a developing country, ardently hopes that achievements in space science and technology will actively contribute, as they should, to the development process of all peoples and to the establishment of a new international economic order. We consider that, as in the case of the international area of the sea-bed and its resources, the principle of common heritage of mankind should be applied to outer space and its uses. If we consider the issue from this approach, we would be entitled to ask for the exploration and exploitation of outer space to be carried out for the benefit of all countries and all peoples, regardless of their levels of scientific and economic development. It would also be appropriate to take measures to ensure access for all countries, primarily the developing countries, free of discrimination or restrictions and in advantageous conditions, to the data provided by

154. Both terms are hopelessly imprecise. Objective classification of discrete territorial communities is often difficult; self-selection is common practice and seems to yield better results. Finding of a collective identity among the countries of the Third World, in particular, was precipitated by the common plight of underdevelopment and dependency. Politically, the "South" emerged as an important center of gravity in international relations in the 1970's, in part by pooling votes in the Group of 77 (now grown to over 100 members). The formative document of the Group of 77 is the Charter of Algiers of October 24, 1967 (*reprinted in 4 THE INTERNATIONAL LAW OF DEVELOPMENT 2415* (A. Mutharika ed. 1979)). The term "Third World" itself may be derived from the conception of a three-sector world economy, as developed by Raul Prebisch and Cesar Furtado in Latin America and Samir Amin in Africa. According to that view, the world economy is split into a core of advanced industrial states, a semiperiphery of socialist countries, and a periphery of underdeveloped countries which are mainly sources of raw materials. *See S. AMIN, ACCUMULATION ON A WORLD SCALE* (1974); Girvan, *Economic Nationalism*, 104 DAEDALUS 145 (1975).

155. The "new international economic order" is designed to bring about a redistribution of values, in particular of wealth, power, and knowledge, in favor of developing countries. It was first formally proclaimed at the 1973 Non-Aligned Summit in Algiers, and entered the international limelight with the Declaration of the Establishment of a New International Economic Order, G.A. Res. 3201 (S-VI) (1974), *reprinted in 13 INT'L LEGAL MAT. 715* (1974). The Declaration stated, in a somewhat sweeping fashion, the right of all states which have been under "foreign occupation, alien and colonial domination" to restitution and full compensation for the exploitation of, and damages to, their natural and other resources. *Id.*, at para. 4f. Other significant documents relating to this movement include the Charter of Economic Rights and Duties of States, *supra* note 122, and the Algiers Universal Declaration of the Rights of Peoples of July 4, 1976, *reprinted in R. FALK, HUMAN RIGHTS AND STATE SOVEREIGNTY 225-28* (1981). *See also* Falk, *The Algiers Declaration of the Rights of Peoples and the Struggle for Human Rights*, in *id.*, at 185; *LEGAL ASPECTS OF THE NEW INTERNATIONAL ECONOMIC ORDER* (K. Hossain ed. 1980); Galtung, *The North/South Debate: Technology, Basic Human Needs and the New International Economic Order*, WORKING PAPER NO. 12, *WORLD ORDER MODELS PROJECT* (1980); INDEPENDENT COMMISSION ON INTERNATIONAL DEVELOPMENT ISSUES (BRANDT COMMISSION), *NORTH-SOUTH: A PROGRAMME FOR SURVIVAL* (1980).

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all remote-sensing satellites and to all space technology in general.¹⁵⁶

References to the phrase "common heritage of mankind" essentially mean claims to organized inclusive management of the resource so labelled.¹⁵⁷ This kind of regime has been sought, in particular, for the geostationary orbit. The Philippine delegation to UNCOPUOS has stated its support for: "the establishment of a legal regime for the geostationary orbit that would recognize and safeguard its character as a common resource of mankind to be managed and used in an equitable manner for the benefit of all States."¹⁵⁸

The clear implication was that the resource was to be used for the benefit of developing states in particular, as the representatives of India,¹⁵⁹ Syria,¹⁶⁰ and Egypt¹⁶¹ pointed out. That meant that a working group within UNCOPUOS should be established that would: "deal not solely with rules governing [the use of the geostationary orbit], as the ITU has done, but also with drawing up norms and principles to make its use more rational and fair."¹⁶² The theme of fairness of use was expanded by the Colombian delegate, who referred to "our *mapa mundi* of under-development, which today, beset by financial penury, the spectre of war and the growing marginalization of its economies, still nurtures the hope that the immense wealth of cosmic resources can restore the

156. Remarks of Mr. Le Kim Chung, Committee on the Peaceful Uses of Outer Space, *supra* note 19, at 32-35. Outer space has also been proclaimed a "common heritage of mankind" in the Algiers Universal Declaration, *supra* note 155, art. 17 ("Every people has the right to make use of the common heritage of mankind, such as the high seas, the sea-bed, and outer space.")

157. For an example of the application of the concept to the sea-bed, see United Nations Convention on the Law of the Sea, Part XI, U.N. Doc. A/CONF.62/122, at 51 (1982), *reprinted in 22 INDIAN J. INT'L L. 491*, at 536 (1982) (hereinafter cited as Law of the Sea Convention). For its application to the Moon, *see Agreement Governing the Activities of States on the Moon and Other Celestial Bodies* of December 5, 1979, art. 11, G.A. Res. 34/68, 34 U.N. GAOR Supp. (No. 46) at 77, U.N. Doc. A/34/46, 18 I.L.M. 1434 (1979) (hereinafter cited as Moon Treaty). For further analysis of the common heritage concept, *see* Wiessner & Jung, *Das völkerrechtliche Regime der geostationären Umlaufbahn*, 32 ÖSTERREICHISCHE ZEITSCHRIFT FÜR ÖFFENTLICHES RECHT UND VÖLKERRECHT 209, at 226-32 (1982).

158. Remarks of Mr. Garcia, Committee on the Peaceful Uses of Outer Space, *supra* note 19, at 58-60.

159. The Indian representative stated that:

We are of the opinion that it is necessary to evolve some criteria and planning methods and arrangements for the equitable and efficient use of the geostationary orbit and of the radio-frequency spectrum. They should be based on the genuine needs identified by each country and should take into account the specific needs of developing countries. Remarks of Mr. Chandrashekhar, Committee on the Peaceful Uses of Outer Space, *supra* note 25, at 42.

160. Remarks of Mr. Kabakibo, Committee on the Peaceful Uses of Outer Space, 247th meeting *supra* note 31, at 46.

161. Remarks of Mr. Fathalla, *id.*, at 48-50.

162. Remarks of Mr. Zarzaga, Committee on the Peaceful Uses of Outer Space, *supra* note 15, at 77 (representing Venezuela).

battered and unjust balance of our earthly habitat."¹⁶³

This aim of global redistribution was to be furthered by the establishment of regional¹⁶⁴ or universal¹⁶⁵ space agencies, and by both quantitative and qualitative transfer of technology.¹⁶⁶ The ultimate end was, according to the delegate from Nigeria, "true self-reliance."¹⁶⁷

The main battleground in the struggle for law in this area, however, has not been UNCOPUOS, but the ITU. Much of the criticism has been directed against the doctrine of prior notification as encapsulated in the slogan "first come, first served." This traditional approach, in the Third World view, has essentially favored the highly industrialized states of the West and the U.S.S.R.¹⁶⁸ Developing states fear they might be denied access to the geostationary orbit and associated frequencies once they acquire the technology to use them.¹⁶⁹ India, the non-aligned movement's coordinating country on WARC 1979 satellite issues, had a particularly frustrating experience. In order to ensure a reasonable orbital slot and appropriate frequencies for its national satellite INSAT 1-B, it had to undergo a two-year long coordination procedure with a "relatively inflexible" prior user, the U.S.S.R.,¹⁷⁰ and ended up paying a "fairly heavy penalty."¹⁷¹ The developing countries have concluded that the traditional approach was not in their best interests. As India's chief delegate noted at WARC 1979, developing countries "are the people who seek access much later, whose resources are limited and who are in fact

163. Remarks of Mr. Rodriguez Medina, Committee on the Peaceful Uses of Outer Space, *supra* note 25, at 21.

164. *Id.*, referring to a Chilean proposal for a Latin American Space Agency.

165. Remarks of Mr. Mehmud, *id.* at 58-60 (representing Pakistan). He thus reiterated a proposal which dates back to the beginnings of space law and activities. See M. McDougal, H. Lasswell & I. Vlasic, *supra* note 1, at 872-971. For more recent discussions, see *Should There Be a World International Space Agency?*, PROC. 20TH COLL. ON THE LAW OF OUTER SPACE, at 15-46.

166. Remarks of Mr. Ayewah, Committee on the Peaceful Uses of Outer Space (247th Meeting), *supra* note 31, at 36 (representing Nigeria). Interestingly, this claim was shared by the delegate from Spain, Mr. Atienza. He stated a "duty incumbent upon the most-advanced countries to pursue an urgent programme of technological transfer under favourable conditions in order that the least-advanced countries can join on an equal footing the community of countries engaged in remote sensing." Remarks of Mr. Atienza, Committee on the Peaceful Uses of Outer Space, *supra* note 15, at 46.

167. Remarks of Mr. Ayewah, Committee on the Peaceful Uses of Outer Space (247th Meeting), *supra* note 31, at 36.

168. T. McPhail, *supra* note 145, at 152.

169. C. Christol, *supra* note 3, at 567.

170. Rothblatt, *supra* note 64, at 15.

171. Rutkowski, *Six Ad-Hoc Two: The Third World Speaks its Mind*, SATELLITE COM., March 1980, at 23, cited in Rothblatt, *supra* note 64, at 15. Other countries that claim to have encountered difficulties gaining access to desired orbital positions and frequencies include France and Mexico. *Focus on a Magnum Opus*, 6 CHRON. INT'L COM., March 1985, at 5, 6.

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not in a position to pay any penalties."¹⁷²

The solution preferred by most of these countries is allotment of frequencies and orbital slots regardless of whether or not they have an immediate use for them: a priori planning. Due consideration also should be given to inequities in present distribution.¹⁷³

The theme of transfer of technology has surfaced as well. During WARC 1979, the technologically advanced states were called on to develop for Third World benefit broadcasts and reception of impulses on single sideband receivers, as well as to provide "the technology, and the capital investment to use it, free without patents, trade marks or license fees."¹⁷⁴

For the first session of WARC-ORB in 1985, the proponents of a priori planning, under the leadership of Algeria and the equatorial states, suggested placing on the agenda the establishment of "principles, technical parameters and criteria for the planning of the orbit and frequency assignments for space services . . . taking into account relevant aspects of the particular geographic situation of equatorial countries."¹⁷⁵

III. Trends in Decision

The presence of both authority and control is essential to the concept of law.¹⁷⁶ Authority, from a realist point of view, may be defined as the "structure of expectation concerning who, with what qualifications and mode of selection, is competent to make which decisions by what criteria and what procedures."¹⁷⁷ Control has been defined as effective power or the condition of having an "effective voice in decision, whether authorized or not."¹⁷⁸ Given the decentralized structure of the world constitutive process, decision-making competency essentially rests with individual nation-states. In external affairs, they have set up common structures to guide their actual conduct to the extent that international intercourse, and thus self-interest in a world of increasing interdependence, requires foreseeability and reliability of behavior. On the most

172. *Id.*

173. McLeod, *The World Takes on the Law of the Air*, 83 NEW SCIENTIST 878 (1979).

174. Raghavan, *Everybody's Wave Length*, 7 DEVELOPMENT FORUM 10 (1979).

175. Report of the Chairman of the United States Delegation to the World Administrative Radio Conference of the International Telecommunication Union, U.S. Department of State, Office of International Communications Policy, TD Serial No. 116, at 75 (1979), cited in C. Christol, *supra* note 3, at 587.

176. Reisman, *A Theory About Law from the Policy Perspective*, LAW AND POLICY 75, 88-89 (Weisstub ed. 1976).

177. McDougal & Lasswell, *The Identification and Appraisal of Diverse Systems of Public Order*, 53 AM. J. INT'L L. 1, 9 (1959).

178. *Id.*

inclusive and general level, the United Nations has been created as such a common structure, endowed with specific competences, i.e. authority. Under and outside of the UN's umbrella, more specialized inclusive bodies perform their tasks of coordinating states' policies on more specific matters.

Control, the power to enforce decisions of inclusive bodies, however, still rests essentially with the traditional actors of international law, the nation-states. A state's stock of power, the impact of its voice in decision, varies widely, according to the base values at its disposal.¹⁷⁹ Nevertheless, it is not only the "Big Powers" which can police the world. Effective sanctioning does not always need the military instrument of a "nuclear heavyweight."¹⁸⁰ As the examples of the EEC, the Pacific Basin countries, and OPEC amply demonstrate, use of the economic instrument may be at least equally successful. Moreover, the nuclear threat may be totally ineffective in deterring "fanatics" from breaking the law. Thus, all its values (power, wealth, enlightenment, skill, etc.) account for a community's impact on the world constitutive process. This impact may vary according to the problem at hand, and its assessment requires the strenuous work of contextual analysis.

The main inclusive arenas of decision-making on the use of the geostationary orbit are the United Nations—in particular, the General Assembly and its Committee on the Peaceful Uses of Outer Space—and the ITU. It is necessary to take stock of their authoritative decisions on the issues at hand, starting with the activities of the UN.

A. The United Nations

The basic document, the "constitution" of outer space, is the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, of January 27, 1967 (1967 Treaty).¹⁸¹ Its main principles, as foreshadowed in the leading treatise on outer space,¹⁸² have been accepted as evidence of customary law on the subject.¹⁸³

179. Almond, *supra* note 115, at 83.

180. Reisman, *Chinese Fallout: Why We Can't Cry "Foul."* THE NATION, Jan. 8, 1977, at 6-7.

181. *Supra* note 125.

182. [I]t would thus clearly appear that all the traditional, technical requirements have been met for establishing a customary prescription that access to, and the use and enjoyment of, outer space are the inclusive right of all peoples, on a basis of complete equality. . . . Any future unilateral challenge of this inclusive right we therefore conclude, can be based, not on considerations of authority, but only on naked power. M. McDougal, H. LASSWELL & I. VLASIC, *supra* note 1, at 227.

183. C. CHRISTOL, *supra* note 3, at 483; A. BUCKLING, DER WELTRAUMVERTRAG 81-82

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One of these leading principles, expressed in Article II, stipulates that outer space "is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means." This seemingly clear and unequivocal prescription would appear to allow immediate dismissal of claims of sovereignty as raised in the Bogotá Declaration.¹⁸⁴ However, equatorial states are right in pointing out that neither this nor any subsequent treaty on outer space has defined its scope of application *ratione loci*.¹⁸⁵ Whether this implies, as they conclude, that the geostationary orbit is not subject to Article II, is a different matter.

Since the beginning of the space age, there have been proposals to fix the limit between airspace (where territorial sovereignty of the subjacent state is recognized) and outer space (where exclusive control is outlawed) at a discrete, unitary altitude. This spatial approach ran into difficulties due to the variety of factors that were proposed for determining that height. It has been said that there are "probably as many criteria as there are speakers or writers on the subject. . . ."¹⁸⁶ The main reason for the lack of consensus on the definition or delimitation of outer space was the competition of a second, totally different approach which discarded the very idea of a unitary boundary between the realms of inner and outer space. This functional view proposed instead to focus on the different kinds of activities in both areas, thus not foreclosing the progress of technology.¹⁸⁷

In the United Nations, both spatialists and functionalists were present.

(1980). As of January 1, 1984, the treaty has been ratified by 89 states, including the United States, the U.S.S.R., Canada, France, the two German states, India and the United Kingdom. U.S. Dep't of State, TREATIES IN FORCE, January 1, 1984, at 288.

184. Brazil, Ecuador, and Uganda have ratified the 1967 Treaty; the other equatorial states would be bound by customary prescription.

185. C. CHRISTOL, *supra* note 3, at 443.

186. Cheng, *The Legal Regime of Airspace and Outer Space: The Boundary Problem. Functionalism versus Spatialism: The Major Premises*, 5 ANN. AIR & SPACE L. 323, 324 (1980). Proposals range from effective control, gravitational effect, actual or theoretical lowest perigee of satellites, von Karman line, limits of air drag or air flight, upper limits of the atmosphere and its various layers, to the prescriptions of the air conventions and absolutely arbitrary heights. See M. McDougal, H. LASSWELL & I. VLASIC, *supra* note 1, at 320-49. See also Cheng, *supra* at 324-25; A. GORBIER, *LEGAL STATUS OF OUTER SPACE* (1980).

187. The main theoretical foundation for the functionalist approach was laid by Professors McDougal and Lipson, who predicted that:

with growing awareness of the difficulties entailed by 'fixed lines' or putative horizontal sheets and of the factors that do and should affect policy, the problem will transform itself from one of boundaries to one of activities, in an appropriate pattern of reciprocities and (potential) retaliations; and the now vexed questions of the legal 'status' of outer space will be discarded for practical purposes, as the question of 'status' was discarded when negotiations on the use of airspace came to the point of concrete agreement.

McDougal & Lipson, *Perspectives for a Law of Outer Space*, 52 AM. J. INT'L. L. 407, 426 (1958). See also N. MATTE, *AEROSPACE LAW* 19 (1969).

Whereas the latter originally had the support of both major space powers,¹⁸⁸ the Soviet Union now has advanced a proposal that would establish the boundary between outer space and airspace "at an altitude not exceeding 110 km above sea level. . . ."¹⁸⁹ This proposal would set maximum limits to airspace, but not foreclose conventional delimitation of outer space at 96 km, the lowest perigee of satellites achieved so far — a test which has been advanced as authoritative for existing customary law.¹⁹⁰ It would also allow rejection of the Bogotá claims. However, only the Federal Republic of Germany¹⁹¹ and Belgium¹⁹² could be convinced to switch sides; the United States, the United Kingdom, and France still hold that there is no immediate need for delimitation of boundaries. The functionalist view degenerated into a "wait-and-see" approach.¹⁹³ Both the strength and weakness of UNCOPUOS lie in its practice of proceeding by consensus.¹⁹⁴ As long as the two leading space powers remain pitted against each other, this question will remain an unresolved topic on the UNCOPUOS agenda, as it has been for more than 20 years.¹⁹⁵

Despite these differences, the international community has reacted rather uniformly to the claims of sovereignty advanced by the equatorial states. The United States rejected them first from a scientific point of view,¹⁹⁶ then by political fiat.¹⁹⁷ Russian dismissals were also unequivocal.

188. Cheng, *supra* note 186, at 324.

189. U.S.S.R. Working Paper, submitted to UNCOPUOS, U.N. Doc. A/AC.105/C.2/L.139 (1983), reprinted in 1983 Report of Legal Sub-Committee, *supra* note 23, at 35. However, space objects should "retain the right of innocent (peaceful) passage over the territory of other States at altitudes lower than the agreed boundary for the purpose of reaching orbit or returning to earth." *Id.* Compare the ITU's definition of space station, *supra* note 97. See also Butler, *supra* note 88, at 98.

190. Cheng, *supra* note 186, at 356. In 1974, the British Skynet-IIA had reached this perigee. *Id.*

191. See Williams, *The Problem of Demarcation is Back in the Limelight*, PROC. 22ND COLL. ON THE LAW OF OUTER SPACE 245, 246 (1980); Zhukov, *Delimitation of Outer Space*, PROC. 23RD COLL. ON THE LAW OF OUTER SPACE 221 (1981).

192. Cheng, *supra* note 186, at 326.

193. *Id.* at 360; A. GORBIEL, *supra* note 186, at 12. For a recent U.S. statement, see the remarks of Mr. Sherman, *supra* note 15, at 34-35.

194. Cheng, *supra* note 186, at 360. See also Christol, *Telecommunications, Outer Space, and the New International Information Order (NIIO)*, 8 SYR. J. INT'L L. & COM. 343, 348 (1981).

195. As early as 1959, the then Ad Hoc Committee on the Peaceful Uses of Outer Space identified the issue of definition/delimitation of outer space and offered solutions on the basis of both approaches. C. CHRISTOL, *supra* note 3, at 438.

196. The U.S. delegate to UNCOPUOS stated that the "gravitational phenomena" referred to in the Declaration of Bogotá depended mainly on the total mass of the earth, not on characteristics of its surface. He added, "If gravity were the exclusive force acting on a satellite in geostationary orbit, the flight path of that satellite would be a vertical drop to the surface of the Earth. We know, of course, that this is not what happens." DIGEST OF U.S. PRACTICE IN INTERNATIONAL LAW 1977, at 659.

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cal.¹⁹⁸ Assertions of sovereignty over an area lying far beyond any contemplated boundary of outer space met with protests from all over the world, including virtually every international grouping¹⁹⁹ except the equatorial states themselves, who lack the power to enforce their claims. The position of the world community is best reflected in the statement of the British delegate to UNCOPUOS:

As regards the geostationary orbit, I should like to reaffirm the view of the United Kingdom that, whatever limits may ultimately be agreed upon for outer space, there is no doubt that the geostationary orbit is inseparable from outer space and is not subject to national sovereignty or jurisdiction.²⁰⁰

Thus, it may safely be concluded that the equatorial countries' claims to exclusive control over the geostationary orbit are neither accepted nor tolerated by the international community. Lacking both authority and control, these states seem to have quietly put their claims to rest²⁰¹ and to have blended them into the more powerful and comprehensive bargaining position of the Group of 77.²⁰² The geostationary orbit remains subject to outer space prescriptions, in particular the 1967 Treaty.²⁰³

Article II of this treaty, however, not only prohibits appropriation by

197. "The United States rejects any claims to sovereignty over outer space or over celestial bodies, or any portion thereof. . . ." White House Press Release of June 20, 1978, cited in C. CHRISTOL, *supra* note 3, at 456 n.115. The United States also advised Colombia prior to the Bogotá Conference that its proposed action would violate international law. *Id.*

198. The Russian position was stated in this way:

The geostationary satellites' orbital space is inseparable from outer space as a whole and all relevant provisions of the [1967 Treaty] are applicable to it, including, *inter alia*, the provision that outer space is not subject to national appropriation by any means whatsoever.

Draft Basic Provisions of the General Assembly Resolution on the Delimitation of Air Space and Outer Space and on the Legal Status of the Geostationary Satellites' Orbital Space: U.S.S.R. Working Paper, Committee on the Peaceful Uses of Outer Space, U.N. Doc. A/AC.105/L.112 (1979).

199. Rejections came from such diverse countries as Argentina, Australia, Belgium, Canada, Czechoslovakia, France, the two German states, Iran, Italy, Japan, Mexico, Nigeria, and Papua New Guinea. See Gorove, *supra* note 3, at 452; and C. CHRISTOL, *supra* note 3, at 470-71.

200. Committee on the Peaceful Uses of Outer Space, (182nd mtg.), U.N. Doc. A/AC.105/PV.182, at 7 (1978) (verbatim record).

201. A recent Colombian article refers to a "lost battle." See Albius, *El Satélite y la Orbita Geostacionaria. Una Batalla Perdida*, NUEVA FRONTERA, No. 382 (May 17, 1982).

202. See *supra* note 133.

203. Goedhuis, *The Changing Legal Regime of Air and Outer Space*, 27 INT'L & COMP. L. Q. 576, 590 (1978); A. GORBIEL, *supra* note 186, at 53; Christol, *supra* note 108, at 36. UNISPACE '82 produced this statement:

Despite lack of agreement on defining the precise boundary between air space and outer space, it is accepted by most nations that GSO [Geostationary Satellite Orbit] is a part of outer space and, as such, is available for use by all States, in accordance with the Outer Space Treaty of 1967.

Report on the Second United Nations Conference on the Exploration and Peaceful Uses of

claim of sovereignty, but also appropriation by means of use. Such forbidden activity has been denounced in the Bogotá Declaration, as well, which pointed to the crowding of the geostationary orbit by the leading space powers and its effective "technological partition."²⁰⁴ However, exploitation of geostationary orbital positions by occupancy was well known and practised at the time the 1967 Treaty was drafted, and was considered part of the "freedom of use and exploration" guaranteed by Article I (2) of the treaty.²⁰⁵ Moreover, effective permanent appropriation by occupation of the orbit is prevented by the limited lifetime of satellites, the inability to maintain them absolutely fixed in a discrete orbital position, and the absence of intent to appropriate on the part of the launching state.²⁰⁶ The charge of appropriation by placing satellites in orbit thus seems untenable.

More serious consideration must be given to another interpretation of Bogotá. The equatorial states see their claims to exclusive control as retaliatory measures for an alleged continuous breach by the space-resource powers of the "common interests rule,"²⁰⁷ the prime provision of the 1967 Treaty: "The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind."²⁰⁸

This paragraph, however, is immediately followed by a reference to three freedoms of outer space: "Outer space . . . shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies."²⁰⁹

It has been argued that the latter provision likens the public order of outer space to that of the high seas. Ambassador Goldberg, U.S. representative to the U.N. in 1967, commented before the Senate Committee on Foreign Relations: "This was sort of a freedom-of-the-seas provision."²¹⁰ Professor Christol has concluded: "This observation indicated

Outer Space, U.N. Doc A/CONF.101/10, para. 281, at 70 (1982) (hereinafter cited as UNISPACE Report).

204. Declaration of Bogotá, *supra* note 120. See also Haanappel, *supra* note 137, at 28.

205. In particular, the French delegate construed the term "use," as distinct from "exploitation," as equivalent to "exploitation," mentioning expressly the activities of weather and communication satellites. C. CHRISTOL, *supra* note 3, at 39-40.

206. *Id.* at 548.

207. Markoff, *The International Space Agency Project, the Bogota Declaration and the Common Interests Rule*, PROC. 20TH COLL. ON THE LAW OF OUTER SPACE 29, 37 (1978).

208. 1967 Outer Space Treaty, *supra* note 125, art. I(1).

209. *Id.*, art. I(2).

210. Treaty on Outer Space: Hearings Before the Committee on Foreign Relations, United States Senate, 90th Cong., 1st Sess. 70 (1967) (hereinafter cited as Treaty Hearings).

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that the negotiators were aware of the *res communis* concepts applying to the ocean and were employing this analogy as they contemplated the legal rules to be applied in the exploration and use, including exploitation, of the space environment.²¹¹

The *res communis* analogy, carrying with it unrestricted rights of use, might be guided by the virtually limitless expanses of the voids of outer space. Space, however, does not consist merely of voids. Even before the 1967 Treaty, there had been a marked tendency to more intense inclusive control over this area than over the high seas. Referring to schemes of direct international administration of outer space, Professors McDougal, Lasswell and Vlasic stated as early as 1963 that:

[T]hese varying ambitious arrangements concerning organized inclusive competence could not be seriously discussed if there were not a universally shared conviction that space already is a common domain of the whole mankind, belonging in equal measure to all under shared competence. Suggestions so comprehensive have never been made even with respect to the maritime domain, which is considered by many as a model arrangement for the emerging public order of outer space.²¹²

This conviction has found its way into the leading provisions of the 1967 Treaty. In contrast to Article 2 of the 1958 Geneva Convention on the High Seas²¹³ as basically retained in Article 87 of the 1982 Law of the Sea Convention,²¹⁴ there is no general "freedom of outer space," no *inter alia* clause to downgrade the three specific freedoms mentioned to mere examples of the states' unrestricted right to use the common resource. Article I (2) of the 1967 Treaty lists these three freedoms as the ones of exploration, use and access to outer space. These three enumerated liberties are qualified immediately, as freedoms to be used "by all States without discrimination of any kind, on a basis of equality and in accordance with international law."²¹⁵

Above all, the 1967 Treaty mandates that space use and exploration shall be carried out "for the benefit and in the interests of all countries."²¹⁶ The U.S. Department of State has expressed the view that this provision did "not create legal obligations with respect to the terms of

The perhaps intentional imprecision of the statement is evident in the use of the phrase "sort of."

211. C. CHRISTOL, *supra* note 3, at 45.

212. M. McDougal, H. LASSWELL & I. VLASIC, *supra* note 1, at 243.

213. Convention on the High Seas of April 29, 1958, art. 2, 13 U.S.T. 2312, 450 U.N.T.S. 82.

214. Law of the Sea Convention, *supra* note 157, art. 87.

215. 1967 Treaty, *supra* note 125, art. I(2).

216. *Id.*, art. I(1).

international cooperation on any existing or future space projects."²¹⁷ To play it safe, the Senate Committee on Foreign Relations attached an "understanding" to its advice and consent to ratification, which stated that "nothing in Article I, paragraph 1 of the treaty diminishes or alters the right of the United States to determine how it shares the benefits and results of its space activities."²¹⁸ With this formula, at least an obligation to share, however imperfect, seems to have been recognized.

In addition the phrase "province of all mankind" indicates a move toward shared inclusive competence. It has been praised for making mankind a subject of international law and providing the starting point for detailed inclusive regulation of resources under the label of "common heritage of mankind." Embryonic, or of broad constitutional generality, the phrase did not carry with it a framework of direct international administration of outer space, the characteristic feature of the "common heritage" concept.

This analysis leads to the conclusion that the 1967 Treaty does not provide for unrestricted use and exploitation of the area.²¹⁹ It is, however, impossible to determine the exact limitations to individual states' activities without getting lost in a quagmire of controversies.

In any event, common interests do not seem to be best served by casting the whole variety of resources assembled in outer space into the Procrustean bed of one legal regime. The flow resource of the voids of outer space is, at least technologically, infinite and inexhaustible; thus space-flight would probably yield the greatest benefits for mankind if individual states could perform this activity free of restrictions, subject only to astronautical rules of the road.

This situation may differ with regard to stock resources, for example, precious metals and minerals on the moon and other celestial bodies. On December 5, 1979, an Agreement Governing the Activities of States on the Moon and Other Celestial Bodies²²⁰ was signed, according to which the "moon and its natural resources are the common heritage of mankind" to be developed and managed under an "international regime" providing for an "equitable sharing" by all states in the benefits derived from these resources.²²¹ This treaty, though not applicable to the geo-

217. Treaty Hearings, *supra* note 210, at 53.

218. S. EXEC. REP. NO. 8, 90th Cong., 1st Sess. 4 (1967).

219. Marcoff, *La Liberté de L'espace—Règle de Droit International à Condition Résolutoire*, 28 ZEITSCHRIFT FÜR LUFT-UND WELTRAUMRECHT 405, 411 (1979).

220. Moon Treaty, *supra* note 157.

221. *Id.* art. 11.

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stationary orbit²²² and suffering from a damaging lack of adherence,²²³ at least demonstrates the necessity of tailoring special regimes for sufficiently different resources according to their nature and the types of their use. Just as the public order of the deep seabed or the continental shelf has been divorced from the general regime of the high seas, the public order of the geostationary orbit must be constructed according to the specific parameters of this resource.

The issue of the geostationary orbit has been on the agenda of UNCOPUOS for more than a decade. Although it largely left the issue for consideration and regulation by the ITU, UNCOPUOS organized, in 1982, the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE '82). In its final report, this conference provided some guidance with respect to future trends in decision relating to the geostationary orbit:

277. GSO [geostationary orbit] is a unique natural resource of vital importance to a variety of space applications. . . . Though not depletable, GSO is a limited natural resource. Therefore, as with any limited resource, . . . its optimal utilization requires co-ordination, planning and/or arrangements. . . .

281. . . . Given the limited nature of the resource, efficiency of use is certainly important and any plan and/or other arrangement that is formulated must encourage greater efficiency. However, efficiency of GSO and RF [radio frequency] spectrum usage should not be a barrier to attempts at technological self-reliance, consistent with the provisions of international regulations. . . .

282. Efficiency of use cannot be an end in itself: it is only a means of ensuring all countries equitable access to this scarce resource. In particular, there are many developing countries which do not now have either the resources or the need to use GSO but are likely to do so in the future. Any planning method and/or arrangement that is evolved should recognize and accommodate the future needs of developing countries and should not result in unnecessary[il]y hastening their plans to the detriment of their financial and self-reliance interests. . . .

288. In conclusion, considering the long-term implications of the growing activities in GSO, any solution on the use of GSO should be both equitable and flexible and take into consideration the economic, technical and legal aspects.²²⁴

222. See remarks of Kolossov, PROC. 23RD COLL. ON THE LAW OF OUTER SPACE 225 (1981).

223. In accordance with Article 19(3), the Moon Treaty entered into force on July 11, 1984, following ratification by Austria (instrument of ratification deposited with the Secretary-General, June 11, 1984). UN J. No. 84/112 (June 12, 1984) at 5. The treaty has been ratified by only four other states: the Philippines (May 26, 1981), Uruguay (Nov. 9, 1981), Chile (Nov. 12, 1981), and the Netherlands (Feb. 17, 1983). M. BOWMAN & D. HARRIS, MULTILATERAL TREATIES: INDEX AND CURRENT STATUS (1984) at 447.

224. UNISPACE Report, *supra* note 203, at 69-71. Following up on UNISPACE '82

Although far from providing any further detail, the basic community policies on the public order of the geostationary orbit have been identified: equitable access and efficiency of use. We will meet them again.

B. The ITU

One element of the twin resource of the geostationary orbit has always been at the heart of the mandate of the ITU: the radio-frequency spectrum. The other, satellites' orbital positions, was added to the ITU's mandate in 1973.²²⁵ At the same Plenipotentiary Conference of Malaga-Torremolinos, the fundamental policy underlying this extension of the mandate was formulated:

In using frequency bands for space radio services Members shall bear in mind that radio frequencies and the geostationary satellite orbit are limited natural resources, that they must be used efficiently and economically so that countries or groups of countries may have equitable access to both in conformity with the provisions of the Radio Regulations *according to their needs and the technical facilities at their disposal*.²²⁶

This provision of the International Telecommunication Convention, the constitutive document of the ITU, was rephrased at the 1982 Plenipotentiary Conference of Nairobi, to change the concluding portion to "taking into account the special needs of the developing countries and the geographical situation of particular countries."²²⁷

While the world community has come to agree upon the principle of equitable access to the geostationary orbit and space communication frequencies, the meaning of equity in this context is far from clear. The

recommendations, UNCOPUOS proposed studies on:

- (a) Assistance to countries in studying their remote sensing needs and assessing appropriate systems for meeting such needs. . . .
- (b) The feasibility of using direct broadcasting satellites for educational purposes and of internationally or regionally-owned space segments. . . .
- (c) The feasibility of obtaining closer spacing of satellites in the geostationary orbit and their satisfactory co-existence, including a closer examination of techno-economic implications, particularly for developing countries, in order to ensure the most effective utilization of this orbit in the interest of all countries. . . .

Report of the Committee on the Peaceful Uses of Outer Space, *supra* note 2, at 6.

225. See *supra* notes 86-87 and accompanying text.

226. ITC, *supra* note 66, art. 33(2). In addition to its new assignment to record orbital positions under Article 10(3)(b) of the ITC, the IFRB was also empowered to "furnish advice to Members . . . with a view to the equitable, effective and economical use of the geostationary-satellite orbit." *Id.*, art. 10(3)(c). The IFRB thus moved from an essentially ministerial to a policy-making role.

227. For the authoritative French text, see 164 TRACTATENBLAD VAN HET KONINKRIJK DER NEDERLANDEN (1983), at 20. For this translation, see Note, *supra* note 109, at 863.

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concept of equity has been a topic of enduring philosophic inquiry and controversy.²²⁸ Unfortunately, it is not possible simply to defer to philosophers for guidance. Nor does reference to the concept of equality clarify the meaning of equity, since equality, too, is used in very different ways (e.g., equality of rights, of opportunities, of conditions, or outcomes).²²⁹

It is not philosophical constructs, however well-conceived, that determine the outcome of decision-making processes. Rather, the outcome of decision-making processes is affected primarily by the context of the specific problem at hand, its microcosm of facts, claims, past trends in decisions, and the base values at the disposal of the rival claimants. One may then agree with Gustav Radbruch's definition of equity as "individualized justice," in the sense of justice as applied to an individual case.²³⁰

Use of the term equity in the inclusive decision-making processes of access to the geostationary orbit had, first and foremost, a negative meaning: the time-honored claim of "first-come, first-served" was "generally disavowed."²³¹ A regime guided by equity would have to be construed so as to prevent a situation in which technological latecomers would have no access to the resource. This latter meaning of equity has developed over time.

Whereas in the 1973 Plenipotentiary Conference version, actual needs and technical capacities were decisive, the 1982 text leaves these special interests of space-resource powers at the periphery. They are replaced by predominant concern for the special needs of developing countries, marking another milestone in the Third World's long march to substantive equality in international relations.

The latter part of the new conclusion, referring to the "geographic situation of particular countries," is rather controversial. Whereas equatorial states hail it as a kind of limited recognition of their claims, th

228. The concept of equity has often been associated with the idea of distributive justice. But, the criteria of distribution differ. For example, Aristotle, under the formula of "to each his due," essentially favored the idea of "proportionate equality" giving each person what he "deserves." NICOMACHEAN ETHICS, Book V, 3. Marx, under the battle-cry "to each according to his needs," sought substantive equality that determined each individual's needs objectively. CRITIQUE OF THE GOTHA PROGRAMME 10 (Int'l Publ. ed. 1938). See also J. RAWLS, A THEORY OF JUSTICE 195 (1971) (concept of equal liberty derived from a fusion of the concepts of liberal equality and democratic equality).

229. O. SCHACHTER, SHARING THE WORLD'S RESOURCES 6-7 (1977). The International Court of Justice has noted that "[e]quity does not necessarily imply equality," for "[t]here can never be any question of completely refashioning nature." North Sea Continental Shelf Case, 1969 I.C.J. 12, 49 (Judgment, Feb. 20, 1969).

230. G. RADBRUCH, RECHTSPHILOSOPHIE 127 (E. Wolf 4th ed. 1950) (author's translation).

231. C. CHRISTOL, *supra* note 3, at 561.

highly industrialized countries interpret it to refer to polar and certain tropical and desert countries where geographical and climatic conditions affect signals from satellites. The same formula was used in Resolution BP of WARC 1979.²³² The Resolution accepted the formula in stating the mandate of the 1985-88 WARC-ORB over the Algerian-equatorial proposal, which had referred to the "particular geographic situation of equatorial countries."²³³ Though this history of the formula suggests the correctness of the industrialized countries' interpretation, submission of the respective understandings in the form of interpretative notes in the process of ratification might be advisable.

The drive for equity led to the planning (i.e. a priori allotment of frequencies and orbital positions) of the Broadcasting-Satellite Service. It is now, after SAT-83, completed for all segments of the geostationary orbital belt. Highly industrialized states, in particular the United States, have perceived it to be in their best interests to accommodate themselves to allotment plans. In Region 2 (the Americas), for example, no blocks of frequencies were allotted, only a high number of very precisely determined channels and orbital locations.²³⁴

Planning of this sort is confined at present to the Broadcasting-Satellite Service. The space-resource states at WARC 1979 successfully blocked attempts by developing countries to turn the 1985-88 WARC-ORB into a forum extending this particular planning approach to the entire orbit.²³⁵ The first session of WARC-ORB, according to Resolution BP, will have to decide "which space services and frequencies should be planned." This resolution, titled "Relating to the Use of the Geostationary-Satellite Orbit and to the Planning of the Space Services Utilizing it," provides, in its operative part:

1. that a world space administrative radio conference shall be convened not later than 1984 to guarantee in practice for all countries equitable access to the geostationary-satellite orbit and the frequency bands allocated to space services;
2. that this conference shall be held in two sessions;
3. that the first session shall
 - 3.1. decide which space services and frequencies should be planned;
 - 3.2. establish the principles, technical parameters and criteria for the planning, including those for orbit and frequency assignments of the space services and frequency bands identified as per paragraph 3.1, taking into account the relevant technical

232. WARC 1979, *supra* note 2, Resolution BP, at 744.

233. See C. CHRISTOL, *supra* note 3, at 587.

234. See SAT-83, *supra* note 45.

235. C. CHRISTOL, *supra* note 3, at 586-87.

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aspects concerning the special geographical situation of particular countries; and provide guidelines for associated regulatory procedures;

- 3.3. establish guidelines for regulatory procedures in respect of services and frequency bands not covered by 3.2;
- 3.4. consider other possible approaches that could meet the objective of *resolves 1.* . . .²³⁶

WARC-ORB is expected to focus initially on the Fixed-Satellite Service,²³⁷ a category including telephone, telex, data, and teleconferencing communications.²³⁸ However, its mandate is broad enough to include discussions of the principles of a general regime of the geostationary orbit.

The conference will have to start from established basic community policies of equitable access to, as well as efficient and economic use of the geostationary orbit. However, there is another recurring theme, a *leitmotiv* of all the conferences of the 70's: assignments of frequencies and orbital positions should not give rise to permanent priorities. It was first phrased in Resolution Spa 2-1 of the 1971 WARC-ST, titled "Relating to the Use by All Countries, with Equal Rights, of Frequency Bands for Space Radiocommunication Services," which provided:

1. that the registration with the I.T.U. of frequency assignments for space radiocommunication services and their use should not provide any permanent priority for any individual country or groups of countries and should not create an obstacle to the establishment of space systems by other countries;
2. that, accordingly, a country or a group of countries having registered with the I.T.U. frequencies for their space radiocommunication services should take all practicable measures to realize the possibility of the use of new space systems by other countries or groups of countries so desiring;
3. that the provisions contained in paragraphs 1 and 2 of this Resolution should be taken into account by the administrations and the permanent organs of the Union.²³⁹

At WARC 1979, the same text (except for the replacement of references to ITU with IFRB) was adopted as Resolution A.Y.²⁴⁰ Ironically,

236. WARC 1979, *supra* note 2, Resolution BP, at 744-45.

237. U.S. Dep't of State, Office of International Communications Policy, United States National Program for the ITU's World Administrative Radio Conference on the Use of Geostationary Satellite Orbit and Space Services 1985/1987, at 2 (1982) cited in Note, *supra* note 109, at 877. The Fixed-Satellite Service is used for point-to-point communication. See WARC 1979, *supra* note 2, Radio Regulations no. 22, at 33.

238. Note, *supra* note 109, at 870.

239. WARC-ST, *supra* note 85, Resolution Spa 2-1.

240. WARC 1979, *supra* note 2, Resolution AY, at 743-44.

its main proponents had changed. Whereas, in 1971, the Third World used it to combat the "first-come, first-served" system,²⁴¹ at WARC 1979, the delegate from the United States worried about allotment plans giving rise to permanent priorities.²⁴² A common fear seems to have been a geostationary orbit chopped up into tiny exclaves, fragments of sovereignty. The ITU stresses that its assignments do not constitute "appropriations";²⁴³ its Radio Regulations are introduced by the statement that it does not, in fulfilling its duties, express any opinions about the status of geographical areas.²⁴⁴ Such endeavors would, in any event, be *ultra vires*. Within the purview of the ITU mandate, however, is the full range of inclusive control established until now over the two composite resources of the geostationary orbit, satellite positions and space communication frequencies. If resolutions against permanent priorities are to have any meaning, they will have to lead to some sort of inclusive control over the period of validity of assignments with respect to both resources.

A first step in this direction has been Resolution BY of WARC 1979, titled "Relating to the Period of Validity of Frequency Assignments to Space Stations Using the Geostationary-Satellite Orbit." According to the resolution, from July 1, 1980 until WARC-ORB,

a frequency assignment to a space station on a geostationary satellite shall be deemed definitively discontinued after the expiry of the period of operation shown on the assignment notice, reckoned from the date on which the assignment was brought into service. This period shall be limited to that for which the satellite network was designed.²⁴⁵

However,

if a notifying administration which wishes to extend the period of operation originally shown on the assignment notice of a frequency assignment of an existing space station informs the Board accordingly more than three years before the expiry of the period in question and if all other basic characteristics of that assignment remain unchanged, the Board shall amend as requested the period of operation. . . .²⁴⁶

To make it perfectly clear, a footnote to the text explains: "The expression 'space station' may apply to more than one satellite provided that only one satellite is in operation at any particular moment and that the stations installed on board successive satellites have identical basic

241. See *supra* notes 168-75 and accompanying text.

242. See *supra* note 150.

243. Butler, *supra* note 88, at 98.

244. WARC 1979, *supra* note 2, Radio Regulations no. 1, at 31.

245. WARC 1979, *supra* note 2, Resolution BY, at 746 (footnote omitted).

246. *Id.* (footnote omitted).

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characteristics."²⁴⁷

Indefinite prolongations of assignments are thus allowed, provided that the nature and degree of use do not change. The initial determination of periods of validity is still subject to exclusive control. This system, however, is only an experimental procedure. The resolution itself stresses "that the application of this Resolution shall not prejudge in any way the decisions of the space administrative radio conference referred to in Resolution 3 [i.e. Res. BP]."²⁴⁸

The common thread linking all these endeavors is a striving for flexibility. Its importance will increase dramatically when large space structures are set up, requiring relocation of a great number of existing space objects.²⁴⁹ Any public order of the geostationary orbit will have to take that factor into account.

A final theme permeating these conferences is a kind of "soft" transfer of technology in favor of developing countries by establishing bilateral and multilateral technical assistance programs, training indigenous staff with the help of scholarships in space-resource states, setting up space information centers at an inclusive level, holding seminars, and advising individual countries on specific space application systems tailored to their needs.²⁵⁰ All these activities are geared towards effective participation of technologically less advanced states in the use of outer space.

The four pillars on which the public order of the geostationary order must be built have now been identified: equitable access, efficiency, economy, and flexibility. Guidance to effective decision-making should strive

247. *Id.* n.1.

248. *Id.* at 747.

249. This relocation will be necessary because of the shadowing effects of large space objects. See *supra* note 101 and accompanying text.

250. See WARC 1979, *supra* note 2, Resolution DG, at 763 ("Relating to the Transfer of Technology"); *id.*, Resolution CZ, at 764 ("Relating to International Cooperation and Technical Assistance in the Field of Space Radiocommunications"); *id.*, Resolution CX, at 765 ("Relating to the Role of Telecommunications in Integrated Rural Development"). Establishment of an "International Space Information Service" has been proposed for 1984. See Report of the Committee on the Peaceful Uses of Outer Space, *supra* note 2, at 5-6. There already exists a very active U.N. Programme on Space Applications. *Id.* at 4-5. The Programme co-sponsors international training seminars on space research and remote sensing applications, with WMO, FAO, UNESCO and the Committee on Space Research of the International Council of Scientific Unions. Both the space information system and the expanded U.N. Space Applications Programme result from UNISPACE '82 recommendations, and are to be supported by voluntary contributions. Remarks of Mr. Jankowitsch, Chairman of UNCOPUOS, Committee on the Peaceful Uses of Outer Space, (245th mtg.), U.N. Doc. A/AC.105/PV.245, at 17 (1983) (verbatim record). Further meritorious work is done by the International Astronautical Federation, in particular, which is preparing an annual report on the development of space technology. Remarks of Mr. Chevalier, Committee on the Peaceful Uses of Outer Space, *supra* note 25, at 28.

to accommodate all of them with a view towards maximizing benefits for the entire global community.

Various regimes to regulate the orbit have been proposed, but as yet no comprehensive authoritative decisions have been made. Legal regulation of other resources is part of our heritage. Making use of that abundant stock of experience, it is possible to explore model regulatory regimes, with a view to devising one that will best fulfill the basic community policies outlined above.

IV. Model Regimes

Blueprints for the future can but gain from lessons of the past. Mankind has faced problems of resource allocation and control ever since there was some sort of organized coexistence. Decisions have been made, and pertinent sets of prescriptions have been refined and diversified, essentially shaped alongside the parameters of the nature and type of the resource and the possibilities of its use, taking into account basic community policies. In some communities, these prescriptions have found their way into written law. A classic example is Justinian's codification of the Roman "law of things."

Up to the present day, publicists refer to *res nullius* or *res communis* in order to describe certain allocations of competence and possibilities of the use of resources under international law. This is not only due to the fact that Latin has been the academic *lingua franca* for centuries. The universalist self-perception of the late Roman Empire²⁵¹ lent itself and its regulations of "internal" behavior to the conceptualization and formulation of policies for the scattered and deeply divided, but nevertheless basically interdependent, universe of today. The Digest still provides us with a general framework of resource regimes, models, which are functionally identical with the oldest and most novel allocations of control under modern international law. In Justinian's main classification,²⁵² these regimes are expressed by the concepts of *res in patrimonio*, *res nullius*, *res communis*, and *res publica*. These general models and their essential features are presented to place the search for a public order of the geostationary orbit into the contexts of past experience, and to develop a general regime which would be most in concordance with both the na-

251. The Roman Empire in its latter days approached universality in self-perception, and the notion of Roman citizenship lost its content as the *jus gentium* was applied uniformly throughout the realm. See R. MACIVER, *THE MODERN STATE* 107 (1926).

252. See W. BUCKLAND, *A TEXT-BOOK OF ROMAN LAW FROM AUGUSTUS TO JUSTINIAN* 182-186 (Stein 3rd ed. 1966); J. THOMAS, *TEXTBOOK OF ROMAN LAW* (1976); P. VAN WARMELD, *AN INTRODUCTION TO THE PRINCIPLES OF ROMAN CIVIL LAW* (1976); F. SCHULZ, *CLASSICAL ROMAN LAW* (1951).

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ture and uses of the resource at hand and the basic community policies as identified above.

A. *Res in patrimonio*

In classical Roman law, these are resources belonging to someone, that is, under a person's exclusive control. In international law, this someone is usually a nation-state. Typically, these resources include the land masses and contiguous areas such as airspace and inland waters, and, to a lesser degree, the territorial sea. They are subject to exclusive appropriation by the nation-states, and, through internal processes of allocation, are often made available to exclusive appropriation by individuals. The key notions that express these exclusive claims are, on the internal level, property, and, in the external arena, sovereignty.²⁵³ The most significant difference between the land masses and other spatial-extension resources is that the land masses are relatively solid. This quality facilitated establishment of permanent sedentary communities with exclusive claims. Also, land masses feature many natural barriers which reinforce the parochial nature of social organization.²⁵⁴

The nature and type of the geostationary orbital resource do not favor claims of exclusive control. There is no contiguity with land masses and other classic exclusive resources. The spectrum cannot be brought under any actor's effective control. The positions of satellites are not stable, and increasingly drift after the depletion of their energy resources. Also, basic community policies crystallized in established trends in decision (e.g., Article II of the 1967 Treaty) oppose claims to exclusive control over any part of outer space. Thus, this model cannot be a general framework for the public order of the geostationary orbit.

B. *Res nullius*

These are things belonging to no one. In contrast to the more encompassing notion in Roman law,²⁵⁵ they can, under international law, be effectively occupied²⁵⁶ and added to the exclusive domain of individual

253. See M. ARSANJANI, *supra* note 118, at 54.

254. M. McDUGAL, H. LASSWELL & I. VLASIC, *supra* note 1, at 803-06.

255. *Res nullius* were further subdivided into *res nullius divini juris* and *res nullius humani juris*. The former, including churches, tombs, and burial grounds, could not be dealt with commercially, whereas the latter, including wild animals and abandoned property, could be acquired under some circumstances. See W. BUCKLAND, *supra* note 252, at 183-84.

256. M. McDUGAL, H. LASSWELL & I. VLASIC, *supra* note 1, at 844-67; I OPPENHEIM, *INTERNATIONAL LAW* 555 (H. Lauterpacht 8th ed. 1955); J. BRIERLY, *THE LAW OF NATIONS* 163 (6th ed. 1963). Discovery and symbolic acts alone were held to have failed to establish exclusive appropriation in the *Island of Palmas Case* (U.S. v. Netherlands), 2 R. Int'l Arb. Awards 829 (1928); Sovereignty over Clipperton Island (France v. Mexico), 26 AM. J.

nation-states. The concept was of great importance in the age of colonialism. Today, the sole examples of *res nullius* territories are newborn islands and perhaps Antarctica.²⁵⁷ As to the latter, no less than seven states asserted claims to exclusive control over segments of it. In 1959, the Antarctica Treaty, concluded by these seven and five other major powers, effectively froze these claims²⁵⁸ until at least 1993, when a new treaty will have to establish a more permanent public order for this vast polar region. With the establishment of permanent bases and activities in the area by the claimants, Antarctica seems to have lost its character as *res nullius*.²⁵⁹ Trends in decision are clearly toward shared inclusive control.²⁶⁰

For the geostationary orbit, occupation could not be a way to establish exclusive control. Satellites, even at the peak of their activities, cannot be maintained absolutely fixed at one point above the earth. Occupied parts of the spectrum could always be subject to interference. Indeed, as noted above, exclusive appropriation is outlawed by the international community. *Res nullius* cannot therefore be a model for the geostationary orbit.

C. *Res communis*

A resource so-labelled is basically open to everyone without a license and free of charge. Under Roman law, it included the air, the sea, and the seashore to the highest winter floods.²⁶¹ Under traditional international law, as set forth in the 17th century,²⁶² the paradigm of *res communis* was the high seas. As the outcome of the Third United Nations Conference on the Law of the Sea seems to portend, however, creeping coastal-state jurisdiction (via proclamation of continental shelves, exten-

INT'L L. 390 (1932). See also M. McDougal, H. Lasswell & I. Vlasic, *supra* note 1, at 830-44.

257. See Hayton, *The Nations and Antarctica*, 10 ÖSTERREICHISCHE ZEITSCHRIFT FÜR ÖFFENTLICHES RECHT 368, 390 (1960). See M. McDougal & W. Reisman, *supra* note 37, at 482-83.

258. Antarctica Treaty, 12 U.S.T. 794, T.I.A.S. No. 4780, 402 U.N.T.S. 71, art. IV (1959). See also M. McDougal, H. Lasswell & I. Vlasic, *supra* note 1, at 798-801.

259. Hayton, *supra* note 257, at 390.

260. The exclusiveness of the "Antarctica Club" is now less acceptable to other states. Moreover, Recommendation XI-1 of the Antarctic Consultative Parties now stresses the interests of all mankind in Antarctica. See Wolfrum, *The Principle of the Common Heritage of Mankind*, 43 ZEITSCHRIFT FÜR AUSLANDISCHES ÖFFENTLICHES RECHT UND VÖLKERRECHT 312, 313 n.4 (1983). According to the preamble to the Antarctica Treaty, it was "in the interest of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes. . . ." Antarctica Treaty, *supra* note 258, preamble.

261. W. BUCKLAND, *supra* note 252, at 182-83; Nunes, *Sources of Public Streams in Modern South African Law*, 1975 ACTA JURIDICA 298, 299 (1976); See INSTITUTES 2.1.1 and DIGEST 1.8.2.1.

262. See GROTIUS, MARE LIBERUM (1633) ch. I (trans. Magoffin 1916).

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sions of the territorial seas, and establishment of contiguous and exclusive economic zones) is leading to a virtual "territorialization"²⁶³ of the sea.

In terms of legal art, *res communes* were regarded as things of common enjoyment, available to all living persons by virtue of their existence. Utilization of the resource was thus an incident of personality, not of property.²⁶⁴ The reason for denying any exclusive rights to resources so classified was their perceived inexhaustibility.²⁶⁵ The waters of the oceans, for example, are vast and seemingly limitless in quantity.

Although the twin resources of the geostationary orbit cannot be exhausted, they can be used only by a finite number of claimants at a given time. They are definitely limited in quantity, and legal regulation of access is necessary to prevent disturbances of minimum world public order from conflicting claims. One such regulatory principle under a *res communis* regime would be priority of use. However, in a situation of acute scarcity, it would deprive latecomers of access to a resource which is generally utilized on a long-term basis or subject them to a fairly heavy penalty, as the Indian example demonstrates.²⁶⁶ Basic community policies and trends in decision have disavowed this "first-come, first-served" maxim, the traditional rule of international communications law, in favor of the formula of "equitable access."²⁶⁷ This principle goes beyond the *res communis* idea, and likens the public order of the geostationary orbit to the last main category of Roman property law, *res publica*.

D. *Res publica*

Publicists have hailed the principle of the "common heritage of mankind" as a novel concept, reflecting the *Zeitgeist* of our time. However, this concept is novel neither in designation nor in content.

As early as 1909, a common law court referred to that term with broad meaning.²⁶⁸ Its content is strongly reminiscent of *res publica*, the last and often overlooked category of the Roman law of things. *Res publicae* comprised public roads, bridges, ports, *fora*, theaters, baths and flowing

263. Graf Vitzthum, *Terranisation of the Ocean: The Tendency Towards a Maritime Law Centered on Raw Materials*, 15 LAW AND STATE 124 (1977); Graf Vitzthum, *supra* note 117, at 314 n.25.

264. J. THOMAS, *supra* note 252, at 129.

265. Nunes notes that *res communes* "were regarded as inexhaustible and sufficient for everyone; thus there was no reason for anyone to own a *res communis*. Not even the State could appropriate it." Nunes, *supra* note 261, at 299.

266. See *supra* notes 170-72 and accompanying text.

267. See *supra* note 231 and accompanying text.

268. Barger v. Barringer, 151 N.C. 433, 66 S.E. 439 (1909) ("Light and air are as much a necessity as water and all are the common heritage of mankind").

rivers.²⁶⁹ They were regarded as the property of the Roman people.²⁷⁰ The common denominator was that they were limited in nature and, at the same time, heavily used. Many competing claims to access and utilization led to extensive regulation by the state.²⁷¹

Scarcity, and sometimes non-renewability, have also been critical factors in labelling a resource part of the "common heritage of mankind." The paradigm has been the deep sea-bed where a scramble for the riches of the ocean floor has been deemed contrary to the common interest,²⁷² and a regime of equitable sharing under direct international administration has been established by the 1982 Law of the Sea Convention.²⁷³ Other resources to which application of the common heritage concept has been at least proposed are the moon,²⁷⁴ technology,²⁷⁵ and "cultural heritage."²⁷⁶ Embryonic forms of the concept are to be found in the 1967 Treaty²⁷⁷ and the 1959 Antarctica Treaty.²⁷⁸

The main characteristic of the common heritage regime is equitable sharing of the resource concerned under inclusive administration. Other features include non-appropriation, demilitarization, freedom of scientific research, and protection of the resource.²⁷⁹ Equitable sharing of resources beyond one state's exclusive control is an established concept in

269. J. THOMAS, *supra* note 252, at 129. Rivulets were privately owned. See W. BUCKLAND, *supra* note 252, at 183 n.4.

270. J. THOMAS, *supra* note 252, at 129; F. SCHULZ, *supra* note 252, at 340; see DIGEST 50.16.15.

271. Heavy use could change the public order of a resource. Flowing water, for example, was originally treated as a *res communis* but ended up as a *res publica* due to increasing use. Nunes, *supra* note 261, at 300-01.

272. See the statement by President Johnson on July 16, 1966:

. . . under no circumstances, we believe, must we ever allow the prospects of rich harvests and mineral wealth to create a new form of colonial competition among the maritime nations. We must be careful to avoid a race to grab and to hold the lands under the high seas. We must ensure that the deep seas and ocean bottoms are, and remain, the legacy of all human beings.

II L.B. JOHNSON, PUBLIC PAPERS OF THE PRESIDENT (1966) 722, 724.

273. Law of the Sea Convention, *supra* note 157, part XI.

274. Moon Treaty, *supra* note 157, art. 11(1).

275. See Draft International Code of Conduct on the Transfer of Technology, preamble, para. 2, U.N. Doc. TD/AC.1/9 annex II, reprinted in 17 INT'L LEGAL MAT. 462 (1978); "Believing that technology is part of universal human heritage and that all countries have the right of access to technology, in order to improve the standards of living of their peoples. . . ."

276. See Goy, *The International Protection of the Cultural and Natural Heritage*, 4 NETHERLANDS YB. INT'L. L. 117 (1973).

277. See *supra* note 219 and accompanying text.

278. See *supra* note 260 and accompanying text and Note, *Thaw in International Law? Rights in Antarctica under the Law of Common Spaces*, 87 YALE L.J. 804 (1978).

279. See Kewenig, *Common Heritage of Mankind—politischer Slogan oder völkerrechtlicher Schlüsselbegriff?* in STAATSRECHT VÖLKERRECHT EUROPARECHT, 385, 388-91 (Münch ed. 1981); Wiessner & Jung, *supra* note 157, at 226.

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international law.²⁸⁰ It is the principle underlying international regimes of rivers and lakes²⁸¹ or transfrontier flow resources like oil and gas deposits.²⁸² What is new is resource management on behalf of mankind as a whole, just as the Roman Empire acted on behalf of the Roman people. Property²⁸³ owned by the most comprehensive community conceivable is the common denominator of *res publica* and the common heritage of mankind. For purposes of international law, the consequences were stated as early as 1968 by Ambassador Pardo: "[T]he notion of property that cannot be divided without the consent of all and which should be administered in the interests and for the benefit of all is also a logical extension of the common heritage concept."²⁸⁴

The practical result of the concept has been the establishment of an International Sea-Bed Authority that acts on behalf of mankind as a whole.²⁸⁵ The authority has a managerial arm, the Enterprise, which is supposed to extract minerals and to transport, process, and market them.²⁸⁶ Under the new Law of the Sea Convention, authoritative decision-making has largely been taken away from individual nation-states—a factor which did not make powerful and technologically advanced communities glowing adherents of the idea. Further, these countries did not feel they were adequately represented in the Sea-Bed Authority.²⁸⁷ Seeing the need, however, for coordinating exploitation of the ocean floor, they concluded among themselves a so-called mini-treaty providing reciprocal recognition of national licenses issued under unilateral deep sea-bed mining acts.²⁸⁸ Whatever the outcome of this battle over the

280. Brownlie, *Legal Status of Natural Resources in International Law (Some Aspects)*, 162 RECUEIL DES COURS 253 (1979); Handl, *The Principle of "Equitable Use" as Applied to Internationally Shared Natural Resources: Its Role in Resolving Potential International Disputes over Transfrontier Pollution*, 14 REVUE BELGE DE DROIT INT'L 41 (1978-79).

281. See Lipper, *Equitable Utilization*, in THE LAW OF INTERNATIONAL DRAINAGE BASINS, 15, at 62-65 (A. Garretson, R. Hoyton & C. Olmstead eds. 1967); THE LEGAL REGIME OF INTERNATIONAL RIVERS AND LAKES (R. Zacklin & L. Cafisch eds. 1981).

282. Lagoni, *Oil and Gas Deposits Across National Frontiers*, 73 AM. J. INT'L L. 215 (1979).

283. The "property" character of the common heritage concept shows up more clearly in its French wording, patrimoine commun de l'humanité.

284. 23 U.N. GAOR First Committee (1589th mtg.), U.N. Doc. A/C.1/PV.1589, at 7 (1968).

285. Law of the Sea Convention, *supra* note 157, art. 137(2).

286. *Id.*, art. 153 and Annex IV, Statute of the Enterprise, art. 1.

287. Graf Vitzthum, *supra* note 117, at 294-95.

288. For the texts of the national statutes, see 19 INT'L LEGAL MAT. 1003 (1980), 20 INT'L LEGAL MAT. 1228 (1981), 21 INT'L LEGAL MAT. 867 (1982) (U.S.A.); 21 INT'L LEGAL MAT. 832 (1982) (F.R.G.); 20 INT'L LEGAL MAT. 1219 (1981) (U.K.); 21 INT'L LEGAL MAT. 808 (France); 22 INT'L LEGAL MAT. 102 (Japan). See also Brown, *The Impact of Unilateral Legislation on the Future Legal Regime of Deep-Sea Mining*, 20 ARCHIV DES VOLKERRECHTS 145 (1982).

ocean floor, the idea of common heritage of mankind seems to have taken hold in the framework of international law. Given the concept's particular features,²⁸⁹ however, it is but one of several regimes conceivable under the notion of *res publica*.

Transposed into today's world constitutive process, the idea of *res publica* refers to patterns of shared inclusive competence reaching beyond *res communis*. The geostationary orbit is a heavily used and, at the same time, finite resource. This factual context and the basic community policy of ensuring equitable access call for a regime of shared inclusive control. Thus, in a most general way, the resource at hand may safely be called a *res publica internationalis*.

This shared inclusive competence may be exercised under various configurations of substantive arrangements and institutional structures. Several such model regimes have been proposed with respect to the geostationary orbit. They may be arranged on a scale, with increasing degrees of inclusive administration, from a market scheme to orbit/spectrum taxes and planning, and, finally, to direct inclusive use of the resource.

1. Market Model

According to this scheme, an "international space condominium" should be created that would auction user rights to the twin resources of the geostationary orbit. Revenues from these auctions would be distributed by that agency "in proportion to nations' shares" in the orbit. These shares would have to be determined by political negotiations.²⁹⁰ The condominium could auction limited user rights at recurrent intervals, or it could be dissolved after distribution of the rents from a first—and last—auction of unlimited user rights.²⁹¹ To achieve static and dynamic efficiency for this scheme, there should be a complete allocation regime, divisible and marketable user rights, long contract periods, and well-defined liability rules.²⁹² A "complete allocation regime" would include all resources that substitute for, or complement each other.²⁹³ The model requires, for example, that traditional long-distance communications via submarine cable, wire or wireless, which are possible substitutes for satellite communications, also be subject to the market scheme.

In view of current heavy regulation of the spectrum resource by nation-states as well as at the inclusive level, it will be difficult to attain

289. See *supra* note 279 and accompanying text.

290. Wihlborg & Wijkman, *supra* note 102, at 43.

291. *Id.*

292. *Id.* at 29.

293. *Id.* at 30.

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such a complete allocation regime. Exceptions to marketability include public goods, such as emergency communications and military services.²⁹⁴ The efficiency of this scheme is therefore doubtful. Flexibility is sacrificed if the condominium (a word which suggests a more intensive form of inclusive control) limits its function to a once-and-for-all sale of user rights. Such a sale would result in virtual conveyance of title to the resources, contrary to the basic policy of avoiding permanent priorities. Finally, the principle of equitable access to the geostationary orbit is not fulfilled by redistribution of wealth through a distribution of rents. As outlined above, developing countries strove for schemes like transfer of technology in order to gain actual access to the resource at hand. Their ultimate aim of self-reliance is furthered best by gaining access to space stations for indigenous communications, educational, medical, and cultural purposes, as well as for the screening of their resources and agriculture. Sometimes, use of satellites for these purposes cannot be substituted except at high costs.

Thus, the market model encounters severe problems in meeting basic community policies.

2. Tax Scheme

The model of levying taxes or use charges on the utilization of the orbit/spectrum resource is based on the idea that the traditional "first-come, first-served" approach leads to a "windfall because its users pay nothing for something that clearly has an economic value."²⁹⁵

As compared to the market model, the difficulty with this is that there probably is no objective economic value on the basis of which the tax or use charge could be computed. If the tax is fixed at an amount at which costs to the investor exceed benefits, the scheme will lead to under-utilization of the orbit, and thus inefficiency. If the tax is too low, congestion is inevitable, and secondary allocation regimes will have to be applied. An auction would resolve this problem.

Furthermore, like the market model, the focus of this scheme is the raising of funds for global redistribution of wealth. This focus misses the concern of the world community for more widespread access to the geostationary orbit.

3. Planning

More oriented toward the goal of widest sharing of the resource are

294. *Id.* at 39.

295. See E. STEINBERG & J. YAGER, NEW MEANS OF FINANCING INTERNATIONAL NEEDS 26-30 (1978) (suggesting the taxation of users of scarce resources outside national jurisdictions).

model regimes that favor inclusive determinations. One such regime would be a lottery, organized by an inclusive administrative body. This random method, however, would be a second choice to a procedure by which scarce user rights are allocated in an equitable fashion.

At WARC-BS and SAT-83, such a system proved workable. It consists of allotment of orbital slots and frequencies ahead of use, i.e., a priori planning. This scheme, based on consensus (and so, similar to the allocation of landing rights at major U.S. airports²⁹⁶) has found a way to translate equity into orbital positions and frequencies. For the Broadcasting-Satellite Service, it essentially met the concerns of technologically less advanced states for later access to the resource.

A sub-model of this planning pattern is the block allotment approach favored by the U.S. for SAT-83.²⁹⁷ It would include blocks of frequencies and blocks or clusters of orbital positions. Both would provide more flexibility for internal decision-making processes, but would not affect the general balance of equity.

Yet the basic problem with current planning systems is their overall lack of flexibility. Insufficient arrangements for changing assignments pursuant to demand and the possibilities of extending assignments repeatedly might lead to the establishment of de facto permanent priorities.

Furthermore, pure a priori planning leads to difficulties with the basic community policies of efficiency and economy of use. As long as some states are not able to use their assigned frequencies and orbital positions, these resources might lie fallow. It has been proposed that these unused places and frequencies might be rented.²⁹⁸ However, this model could only lead to efficiency if there were a duty to lease on the part of the state to which the resource was allotted.

4. International Space Agency

The last model expresses the highest degree of inclusive control. It posits the creation of an international space agency with enterprise functions, along the lines of the International Sea-Bed Authority.²⁹⁹ It would take over planning and execution of space-related activities, in particular construction and launching of space vehicles.

Creation of such a body would face more serious opposition than the Sea-Bed Authority, even if it were to operate alongside national space

296. See Grether, Isaac & Plotz, *The Allocation of Landing Rights by Unanimity Among Competitors*, 71 AM. ECON. REV. PAPERS & PROC. 166 (1981).

297. See *supra* notes 152-53 and accompanying text.

298. Hart, *A Review of WARC-79 and its Implications for the Development of Satellite Communications Services*, 12 LAW. AM. 442, 458 (1980).

299. See *supra* notes 165, 285-86 and accompanying text.

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agencies, as in the regime of the ocean floor. First, density problems on the geostationary orbit are so acute that parallel assignments are not possible. Second, space technology is in the vanguard of innovation. It is difficult to conceive of the advanced technology countries internationalizing that resource completely. Further, the competition between the U.S. and the U.S.S.R., which culminated in the race to the moon, is perceived to have produced the most significant advances in exploration and use of outer space, as well as overall technological progress. Third, the array of military satellites placed in geostationary orbit is a reminder of the basic goal of all states—security. During the 1978 special session of the United Nations General Assembly on Disarmament, France proposed the establishment of an International Satellite Monitoring Agency (ISMA). Although the annual costs of ISMA to the international community would be less than one percent of total yearly expenditure on armaments,³⁰⁰ this suggestion has not yet been taken seriously by the superpowers. Finally, an International Space Agency would encounter problems similar to those faced by the Sea-Bed Authority regarding the composition of its principal organs.³⁰¹

All four basic model regimes of the geostationary orbit thus exhibit serious deficiencies when compared to the requirements of the global community for the public order of the orbit. New ways have to be found.

V. Recommended Regime

It is virtually impossible to fulfill all four basic community policies outlined above. Tradeoffs will always have to be made among the demands of equitable access, flexibility, efficiency, and economy. The following system of options, blended with elements of the models described above, is designed to assure to the fullest extent possible that the essentials of the public order of the geostationary orbit are met. It consists of six basic elements:

1. World administrative radio conferences of the ITU allot, on a consensus basis, options to use parts of the spectrum and the orbital arc to individual countries. This process could begin at the 1985 WARC on the Geostationary Orbit. As a matter of preference, allotments should cover a block of frequencies and orbital positions rather than individual channels or slots.
2. The same inclusive processes periodically review the basic balance of equity struck through the initial allotments and adjust them in

300. See SIPRI, *supra* note 33, at 107-08.

301. See Graf Vitzthum, *supra* note 117, at 294-95.

- response to changes in technology, demand, and territorial configurations.
3. Options are exercised by utilizing the respective frequencies and orbital positions. Spacecraft approaching the end of their activity or their authorized period of use have to be removed from the orbit.
 4. Control over the use of the resources represented by unexercised options remains in the hands of the international community. Acting on its behalf, the IFRB, as custodian of an international public trust, leases the unused slots and frequencies to the highest bidder. The duration of the lease is chosen with reference to the time when the original holder of the option will be able and willing to use the resource as well as with reference to the techno-economic implications of the various space systems, such as the lifetimes of the satellites.
 5. For the duration of the lease, rights to exercise the option are suspended. After expiration of the lease, these rights revert to the original holder.
 6. Revenues from the auction of unexercised options are used to further the transfer of space technology so as to enable all countries to gain direct access to the geostationary orbit. For this purpose, the creation of a world space technology center should be envisioned.

Evaluating this system in light of the four community policies outlined above reveals the advantages of this approach.

First, this system would promote efficiency of use. Exercised options and the rental of unused portions of the orbit and spectrum would ideally lead to maximum use of the resource. Here, maximum use means optimal use. Stationing satellites at safe distances from one another and transmitting signals at non-interfering frequencies have no negative impact on the environment.

Second, economy of use would be promoted by the market elements of the scheme, as well as by the restrictions imposed on individual countries by the framework of allotments. Some basic economic analysis will occur in evaluating the rented slots and frequencies and possible substitutes. For example, the relative costs and benefits of space stations will be weighed against alternative transmission by terrestrial or transoceanic cable, using new fiber-optic technology. A complete external and internal market scheme for both kinds of resources will probably not be attained, however.

In addition, scarcity of allotted options will promote intensity of use.

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The development of improved station-keeping technology to permit closer spacing of satellites, the combination of several applications on one spacecraft, and the use of sophisticated methods to increase the use of the radio-frequency spectrum will be pursued. The obligation to remove inactive and drifting satellites from geostationary orbit will also contribute to a more economical utilization of the resource.

Third, periodic reviews of the options allotted to individual countries will help to adjust the balance of equity struck by the initial consensus to new developments of technology, demand, and composition of the world community. Rearrangements might be necessary in order to accommodate large space structures of the future. Territorial changes might require new assessments of the needs and demands of particular nation-states. Outcomes of these reviews will be implemented by the duty to remove objects from the assigned orbital location if the right to use is terminated by the international community. This flexibility on the inclusive level is accompanied by greater regulatory margins for exclusive decision-makers. They would be entrusted with the division of allotted blocks of frequencies into individual channels as well as the arrangement of satellites within a continuous position on the orbital arc.

Finally, this system would meet the concerns of technologically less advanced countries for maintaining a basic option to use the geostationary orbit once they are able and willing. This aim is achieved by linking rental periods to the estimated time at which these countries will reach that point. However, it should be taken into account that for technical as well as economic reasons, satellites are designed for a certain lifetime, now an average of ten years. This fact should also be considered in determining the period of particular leases.

The goal of equitable access would not be furthered by distribution of benefits alone. To promote widespread direct access to the geostationary orbit, revenues from auctions of unused spaces and frequencies should be used to set up an inclusive system of information on space activities. This system would provide information on benefits from uses of outer space as well as on existing space systems and access thereto. Evaluations of national industrial capabilities, possibilities for the development of space technology, and present international mechanisms for the transfer of space technology would be made.³⁰² At an inclusive level, the auction revenues would help to assemble critical resources of competence to establish national or regional space capabilities. At a later stage, these

³⁰². See Leister, *Space Technology for Development: Dreams and Realities*, PROC. 22ND COLL. ON THE LAW OF OUTER SPACE 169, 174 (1980).

revenues might also be used to finance inclusive policing of the orbit, through removal of unauthorized and drifting satellites and space debris. Such mine-sweeping missions, if technically possible, would probably have to be executed, at first, by the leading space powers. Liability rules for leaving space junk on the orbital lane would also have to be formulated and enforced at an inclusive level.

For the effective implementation of the inclusive regime suggested, it is critical that initial allotments and changes of options be arrived at by consensus. Space law has been written successfully in this way by UNCOPUOS, and through the ITU's worldwide radio conferences.

The institutional structure for the recommended regime could be provided by a novel, specialized body, an International Space Agency. It could focus on the particular problems of outer space by collecting all available information and furnishing advice on space science and technology. It would also provide a basic framework for other resource regimes in outer space. For example, if the global community ultimately were to decide to begin space mining³⁰³ under an inclusive regime, as foreshadowed in the 1979 Moon Treaty, such a decisionmaking body would already be in place.

The times, however, do not favor grand designs. Thus, it seems more conducive to the outlined regime for its aims to be realized in the framework of a body that has already established a tradition of quiet, but extraordinarily efficient, accomplishment of its tasks: the ITU. Allotments of options to use the orbit/spectrum resource would best be effected at its world administrative radio conferences. Authoritative decisions of these conferences would be based on consensus, as they are now. Auctions of orbital slots and frequencies as well as policing functions could be effected by the IFRB. These custodians of an international public trust have already moved from a ministerial function to policy formulation and an advisory role on the use of the orbit/spectrum resource.³⁰⁴ To underscore this change of role, its designation might be changed to "International Orbit and Frequency Board (IOFB)." Under the auspices of the ITU, a space technology center should be established in close cooperation with the United Nations' International Space Information Service.³⁰⁵ It would perform the functions outlined above relating to development of national and regional space capabilities.

303. For a discussion of the technical possibilities of space mining, see Gaffey & McCord, *Mining Outer Space*, 79 TECH. REV. June 1977, 51; O'Leary, *Mining the Apollo and Amor Asteroids*, 197 SCIENCE 363 (1977).

304. See *supra* note 226.

305. See *supra* note 250.

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Like any model, this proposed system is based on a set of assumptions about the state of technology, the structure and outcome of world constitutive processes, and present expectations about future developments. Radical changes in technology could solve or alter some of the constraints on which the need for a public order of the geostationary orbit is based. A breakdown in elite restraints on the peaceful use of outer space, or some fundamental shift in the primacy of the nation-state in the structure of international relations, could undermine other premises of the regime.³⁰⁶ For the present and the foreseeable future, however, the system proposed would satisfy as far as possible the aspirations of all participants in the global arena.

Conclusion

The era of scarcity has reached outer space. With regard to the twin resource of the geostationary orbit, limits to growth are set by dangers of space object collision and shortage of frequencies. Access to this non-depleting but finite resource has to be provided on an equitable basis. Other basic community policies with regard to orbital positions and space communication frequencies include flexibility, efficiency, and economy of use.

These goals would be best served by allotting to individual states options to use the resource, through worldwide consensus. Inclusive leasing to the highest bidder of unused orbital positions and frequencies would lead to optimum use of both orbit and spectrum. It would also ensure revenues for a world space technology center designed to enhance capabilities of direct access to outer space by all countries. Space powers would benefit from inclusive guarantees for their investments in the area, as well as from non-discriminatory leasing arrangements and the adaptability of the options system to changes in demand and technology. Technological late-comers would be provided access de jure, and ultimately, de facto.

Technology and human ingenuity have made the band of space around the planet a natural resource of advanced global civilization. They have not devised an equally advanced system of public order for its regulation. The model developed here takes account of the imperfect character of international politics and law in the absence of effective centralized institutions by seeking to harness the enlightened self-interest of state elites.

306. See Reisman, *Private Armies in a Global War System: Prologue to Decision*, 14 VA. J. INT'L. L. 1, 31-33 (1973).

It rejects a sterile conception of zero-sum. Instead, congruence of interest and the experience of mutual benefits would be the foundation for the public order of a resource now universally recognized as indispensable.